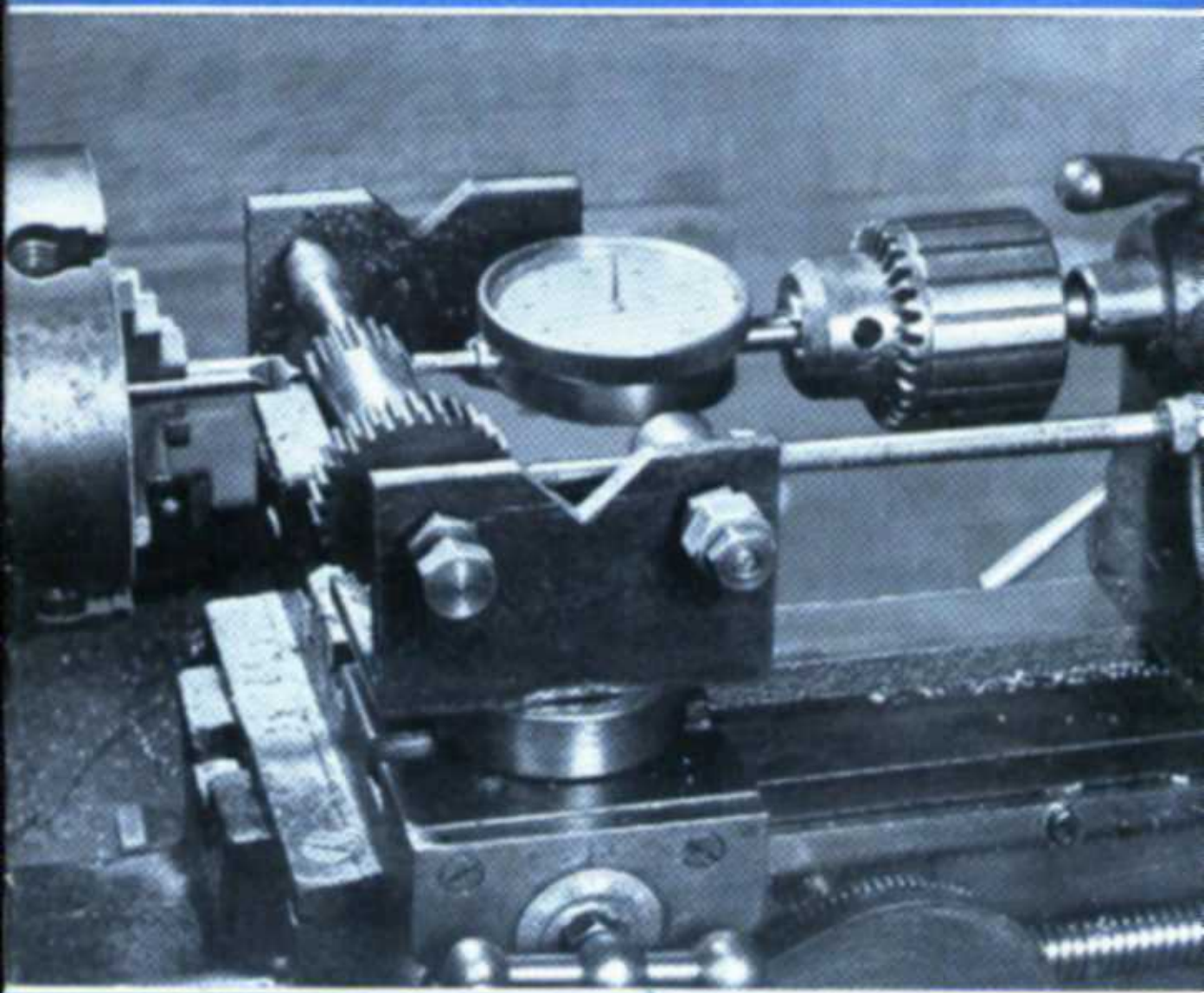
THE MODEL ENGINEER



IN THIS ISSUE

● AN AUTOMATIC CROSS-FEED FOR THE M.L.7 LATHE
GROOVING V-PULLEYS ● A SIMPLE ELECTRIC CLOCK
● A MODEL STEAM DRIFTER ● QUERIES AND REPLIES
MODEL POWER BOAT NEWS — ACTIVITIES IN THE U.S.A.

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THE
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CONTENTS

SMOKE RINGS	425
A MODEL STEAM DRIFTER	426
"L" PLATES AT THE BENCH	430
A SIMPLE ELECTRIC CLOCK	432
L.B.S.C.'s "NETTA" A North-Eastern T-class "Mitey" Hauler in five gauges	435
MODEL POWER BOAT NEWS Activities in the U.S.A.	438
THE MODEL POWER BOAT ASSOCIATION Regatta List for 1954	440
AN AUTOMATIC CROSS-FEED FOR THE M.L.7. LATHE	441
FROM START—TO FINISH Describing the Building of a "M.E." Exhibition Prize-winner	444
GROOVING V-PULLEYS	448
READERS' LETTERS	450
QUERIES AND REPLIES	452
WITH THE CLUBS	453

Our Cover Picture

Among the many duties which the small lathe is called upon to perform, one of the most frequently discussed is that of cutting gears, and various methods of carrying out this operation have been described in "The Model Engineer." The method illustrated in the photograph was adopted by a reader from Littlehampton, who wishes to be known by the initials "C.G.S.," in making the 15-toothed feed pinion for a sensitive drilling machine from very tough alloy steel. It will be seen that an end-milling process was employed, with a cutter formed to the shape of the tooth space. The pinion was supported between centres, on angle brackets mounted on the lathe cross-slide, with its axis exactly at lathe centre height, and indexed by means of a 30-toothed change wheel and a simple detent stop. A dial test indicator held in the tailstock chuck enabled the depth of tooth to be accurately gauged. While this method is slow compared with the use of an orthodox disc-type of cutter, it avoids the need for vertical feed adjustment, and the other fixtures are of a very simple nature.

SMOKE RINGS

Testing the Track

ON APRIL 1ST, a special train was run by the Western Region of British Railways; it seems to have "astonished the natives" some of whom, in view of the date, "didn't believe there was no such animal"! A "Castle"-class engine, with a train of five coaches conveying members of the engineering staff, was run from Paddington to Steventon and then from Didcot back to Paddington, on a very fast schedule each way. The train was booked to leave Paddington at 10.20 a.m. and arrive at Steventon at 11.9 a.m.; this meant 49 minutes for 55½ miles, start to stop. The return run was from Didcot, depart 11.53 a.m., to Paddington, due at 12.43 p.m., 53 miles in 50 minutes. This return timing was to include a long permanent-way slack to 15 m.p.h. at Twyford, owing to new track having been put down the previous Sunday.

We saw the train arrive back at Paddington; headed by engine No. 7036, *Taunton Castle*, it glided slowly and sedately down the long length of No. 8 Platform and came to a stop at precisely 12.39 p.m., four minutes before time, having run the 53 miles from Didcot start in 46 min. Its "passengers" had been recording the condition of the track during their 2-hours-and-13-minutes absence from London.

Changes at Southport

THE SOUTHPORT Model and Engineering Society has a new hon. secretary, who is Mr. H. E. Hatley, 57 Rufford Road, Crossens, Southport, to whom all future communications should be sent; also, Mr. A. Moore has succeeded Mr. M. Kelly as chairman.

It appears that quite a lot has been happening in the society since we last heard from it. Once more, the "OO"-gauge model railway is being rebuilt; in fact, a lot of the work has been completed and the members hope that, when all the alterations are finished, five trains at once can be brought under control, which will be a considerable improvement over the previous possibilities. It will certainly add much to the interest and fun of operating the line.

At the same time, the society's Grand Prix car track is in process of being renovated. Car design has developed considerably since last year, most cars now featuring steering and revised transmission, while at least one member is toying with the idea of automatic gears. Incidentally, the society still extends an open invitation to anyone who owns a miniature car which will fit the track and is powered by an engine of 1.5 c.c., or under, to race it against the society's own cars.

It is evident from all this that intensive preparations are in hand at Southport for plenty of activity during the coming season, and we shall look forward to hearing more about it later on.

B.R. New Training School

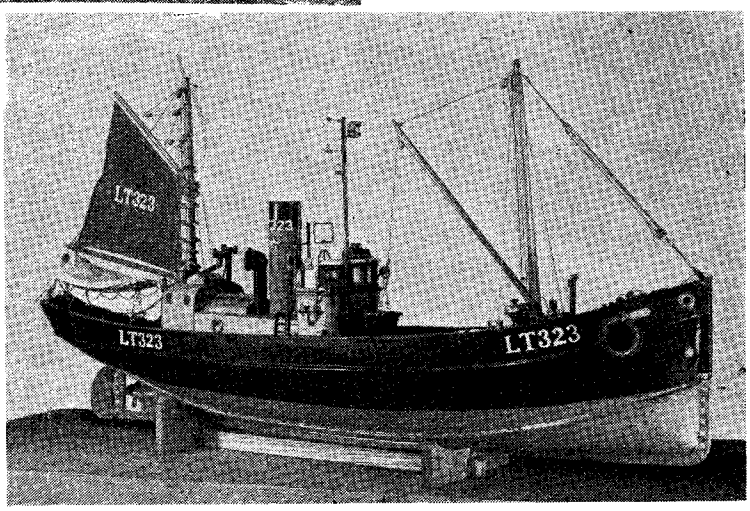
A LEARN-AS-YOU-EARN training school was opened on April 2nd at Wolverton Carriage and Wagon Works by Mr. J. W. Watkins, Chief Regional Manager of British Railways (London Midland Region). The school, which will accept boys leaving school, is fully equipped with a large workshop with the necessary machines and lecture and film projection rooms. Trainees will receive practical instruction, under workshop conditions for a full year, in joinery, coach bodybuilding, welding, painting and electrical work.

At the end of the 12 months course in the training school, apprentice-trainees will be transferred to the works, where training will be continued up to the age of 21. The training will follow a carefully planned schedule that guarantees every apprentice being given the same opportunity in accordance with the principles of the progressive system of workshop training which operates throughout the works.

A model Steam Drifter

BASED ON A LOWESTOFT FISHING CRAFT

By L. W. Burcham



The prototype (after being modernised) and the model

HAVING survived a fourteen-week spell, in the North Middlesex Hospital in 1946 (thanks to the skill of the staff), I came to the conclusion that a more profitable use could be made of my spare time than running round doing odd jobs for all and sundry who, incidentally, cared little that I very nearly came out of that hospital neatly cased in wood.

The decision to take up modelling as a spare time pursuit was a happy one. I have found in it a most satisfying medium and one that can be used to good effect when my employers decide that I have been with them long enough.

My first attempt, a $\frac{3}{4}$-in. scale B.17 locomotive is still "in course of construction," but in August 1949, whilst on holiday at Lowestoft, I took many snaps of fishing craft and casually noted a few measurements of a drifter which at that time was in dry dock having its hull painted, etc. With the winter evenings drawing in, a study of the photographs, etc., made me decide to start building a fishing vessel, which at that time seemed fairly original; since, it seems, everyone, even Triang toys, are making them. The name of the vessel in dry dock referred to was *Faithful Star*, which sounded attractive enough to adopt for modelling.

A survey of material from under the bench produced a fair supply of odd pieces of aluminium sheet, strip and angle, and this was reserved against the time for starting construction. The first procedure was to make such detailed drawings as were possible from the measurements to hand, filling in the gaps from the photographs. The scale selected was $\frac{3}{8}$ in. to 1 ft. making a boat about 30 in. in length, this also fitted in with the material available. In conjunction with the drawings a cardboard "mock-up" was made, as in the absence of measurements the correct hull lines could only be obtained by trial and error. From the card bulkheads, the metal ribs were finally shaped. "Plating" of stiff card (old office files) was fitted and held temporarily with small and large bulldog clips until the correct lines were obtained, the clips being replaced with gummed paper strip when complete. My youngest son (8) at this stage hinted that it was time I stopped playing at toy ships and gave it to him.

Lack of accurate measurements caused me to make one serious error. The "mock-up," when complete looked much too wide in the beam and not having confidence in my handiwork I made the metal hull $1\frac{1}{2}$ in. too narrow with the result that engine space was very severely restricted. It may be worth mentioning here that fishing craft hulls are patterned on those of the lifeboat to give them the maximum stability and buoyancy in the worst conditions.

The Keel

To commence construction, the keel of $\frac{3}{4}$ in. $\times$ $\frac{1}{8}$ in. aluminium was formed edge-on in one continuous piece from stem to stern, an additional piece of the same section being fitted flat to the top of the stern tube

and rudder support plate and carried up to form the main anchorage of the stern plates. A brass tube was inserted to carry the rudder stem and a copper tube to carry the driving shaft (Fig. 1).

Ribs of ¼ in. × ⅛ in. strip were next cut and formed to the shapes determined by the card bulkheads in the "mock-up" and 14 of these were spaced equally along, and secured to the keel with small saddles fixed with 10-B.A. screws (detailed on Fig. 1). Two further strips ¼ in. × ⅛ in. were riveted to inside of the ribs from stem to stern at deck level and frames of ¼ in. × 18 s.w.g. angle to form the openings for engine room casing and fish hold were built up and riveted to these strips. The hull in the model is clear and unobstructed, whereas in practice there are three bulkheads fitted and in order to maintain a rigid structure, three ¼ in. × ¼ in. × 16 s.w.g. angle pieces were fitted as cross members to one of which the foremast tabernacle and decking were ultimately fixed. The tops of the ribs were finally secured with formed angle to finish the bulwarks. Before the hull was plated, six ¾-in. × 6-B.A. screws were fixed to the ribs 3 in. apart to provide an anchorage for the power unit.

The longer evenings had by then arrived and the job was consigned to the shed roof, but as time permitted I continued to construct the many odds and ends of fittings, these being detailed in Fig. 2.

When the urge came to resume, I had to look around for suitable material to plate the hull. I was fortunate to secure some surplus strips of aluminium face ply from a van builder friend, the aluminium, when stripped from the wood, proved to be just the right gauge to form the plates. Serious consideration was given to plating the hull as in the real job, but it was decided that the extra work involved, whilst being very clever, was hardly justified and as "L.B.S.C." says, there is a limit to what one can scale, and rivets are to my mind one of those things.

However, I eventually used long narrow strips, three layers for each side, riveted together with strakes of half round ⅛-in. strip on to the ribs, allowing a fair amount of overlap on each strip. The plating was carried down each side of the keel plate, also covering the sides of the stern tube and rudder support plate and riveted thereto, thus forming fairly tight joints which were finally waterproofed by running Chattertons compound into them on the inside of the hull with a hot iron.

Bilge keels of formed angle ⅜ in. × ⅜ in. × 20 gauge aluminium were riveted on the port and starboard sides.

The whole of the hull was then painted inside and out with two coats of red oxide, the resultant smell being 100 per cent. shipyard.

Before proceeding to the deck and its fittings, a piece of ⅜ in. × ⅜ in. square hardwood was fitted into the hull forward of the fish hold to form the tabernacle for the forward mast, the hinges being made with two brass plates fixed to the upper part with 5-B.A. screws.

The deck planking was cut from thin teak in ⅛-in. strips, shaped to the bulwarks, deck house and hatches, and secured by 10-B.A. screws so far as possible at points likely to be covered by fittings, etc., otherwise the heads were countersunk and filled with home made teak plastic wood. To give the correct appearance of caulked planking, grooves were marked in the wood and filled with black indian ink.

Another rest from hull construction being indicated, it was again consigned to the shed roof and a start made on the deck house and engine room casing. These were constructed of 20-gauge aluminium

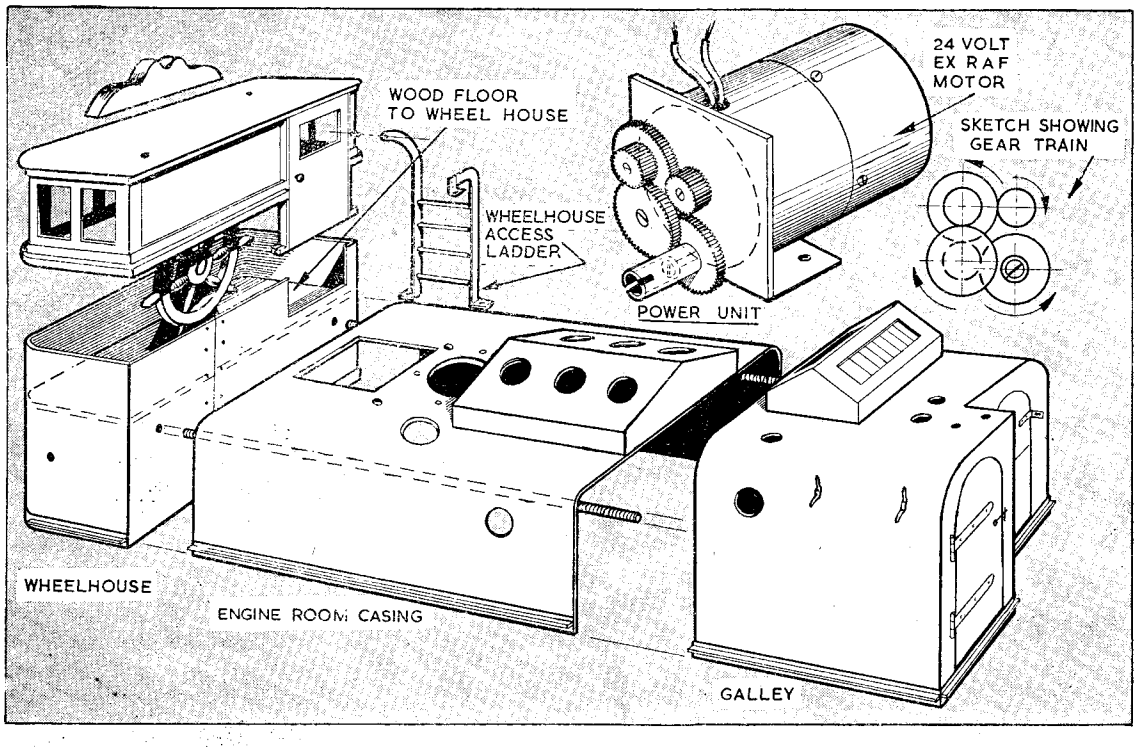


Fig. 3. An exploded view, showing the power plant and the component parts of the structure

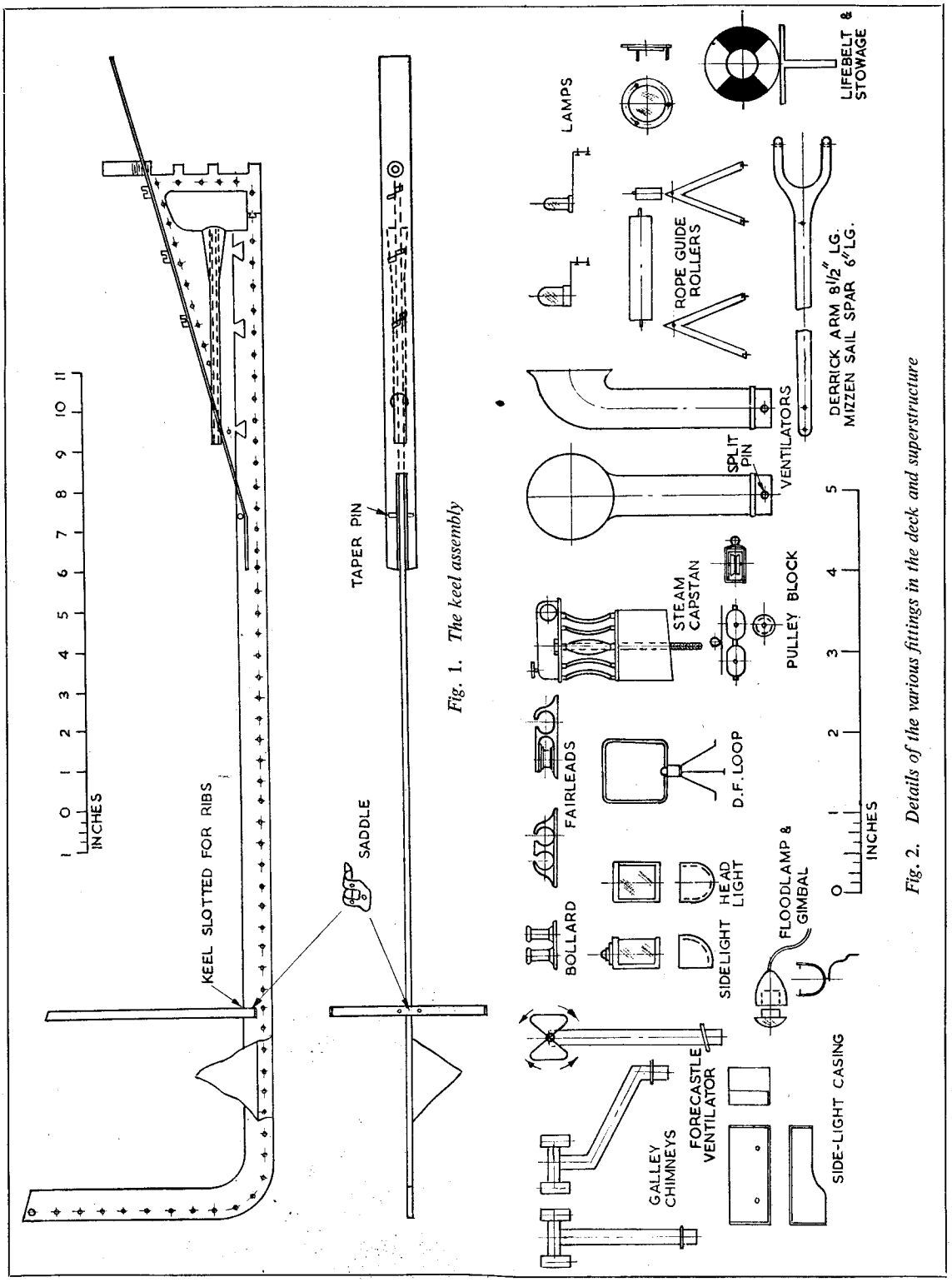


Fig. 1. The keel assembly

Fig. 2. Details of the various fittings in the deck and superstructure

sheet in three parts, i.e., galley with fanlight, engine room casing with fanlight and wheelhouse base; wood formers were made to which to bend the metal, butt joints being riveted to backing strips. The three units were subsequently joined with formed angle pieces riveted to the undersides of the engine room casing, and to give greater firmness, two 2-B.A. rods were fitted to clamp the engine room casing between the galley and wheelhouse sections. Finally the lower edge was fitted with angle to form a lip to locate the casing into the opening in the deck, the casing being then easily removable to service the power unit and battery.

The funnel was already made in my mind's eye, but when I came to sort out the sundry old electrolytic condenser cases which I had stowed away, I found none was anywhere near the correct size; a pity, as the screwed base made a good fixing. The only thing to do, therefore, was to roll this item from sheet with the butt joint riveted to a backing piece inside, the base fixing being a turned aluminium ring made from $\frac{1}{4}$-in. metal and riveted to the base, three 10-B.A. clearance holes providing for fixing to the casing (Fig. 4). Two bands of half round $\frac{1}{16}$-in. aluminium wire, one at the extreme top, the second 1 in. down, were riveted on, this top section being subsequently painted black. Two five pointed stars cut from odd pieces of aluminium were fitted to the funnel with 10-B.A. screws. The steam whistle and safety-valve exhaust pipe were made of $\frac{1}{8}$-in. copper tube the whistle being formed by cutting apertures in each side, a right-angled piece of wire fitted immediately below serving as the valve. Both pipes are secured with 10-B.A. screws threaded into them and nutted inside the funnel. The registration numbers called for quite a bit of care and concentration. The procedure adopted was to stencil on two pieces of gummed paper, a broad line being drawn across the middle to provide a link for the letters and numbers. This was pasted on to a piece of hull plate and with the dexterous use of a small drill and swiss files a fairly satisfactory job resulted. Riveting was done with snippets of aluminium filed to a point and wedged into holes drilled with a No. 70 drill, the ends being turned over inside the funnel. This No. 70 drill business is all very well in a pin vice, but one's hands suffer when there is a lot to do. I think the next thing to make is a flexible shaft before returning to the locomotive or the drifter/trawler *Boston Comet* now on the drawing board.

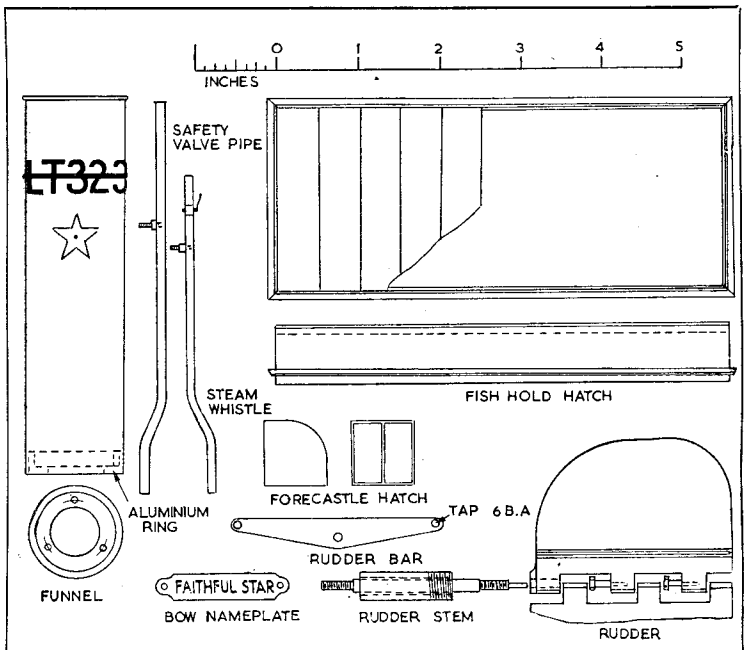


Fig. 4. Funnel, hatch, rudder and other details

The stove chimneys for the galley and accommodation were formed from strips of tin on $\frac{3}{16}$-in. rod and soldered down the seam. Suitable pieces were then cut and soldered to make the "H" tops and bends, incidentally all flues work and are not blanked off at the "H." The forward accommodation chimney is just a straight pipe with movable wedge shaped pieces fitted to the top, it is certainly a queer hook up, but apparently it works very well under what must be very exacting conditions.

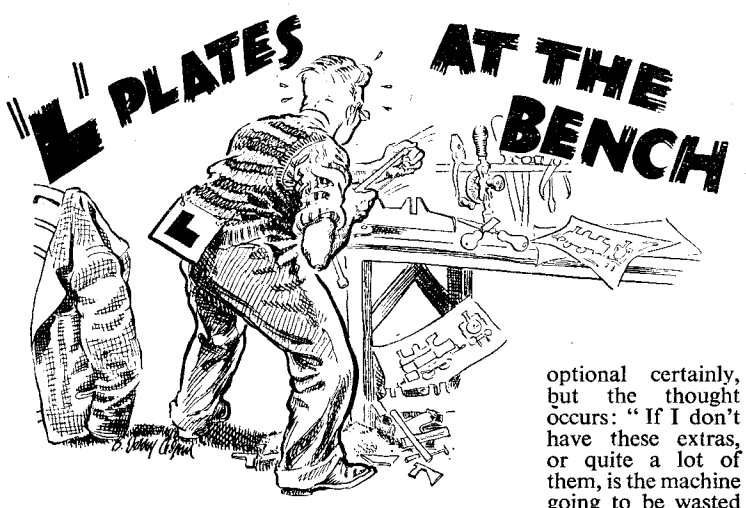
The wheelhouse (Fig. 3) was constructed of teak, the roof being first shaped to correct size and laid top downwards. A groove was next cut to the shape of the windows and small holes drilled to take the frame pieces, the sill (formed of three strips, front and two sides), were likewise grooved and drilled. The ends of each frame upright were reduced to fit the drilled holes and the whole glued and clamped together. The wheelhouse door frame was similarly fitted and glued together with the solid back. The door was made separately and fitted in tight, but not hinged. The windows consisted of small strips of celluloid snapped into the top and bottom grooves of the frames and kept in place by small fillets of teak glued to each side of the frame uprights. For the floor of the wheelhouse, a piece of wood shaped to size was pressed into the metal frame and pinned through. On this is mounted the steering wheel, which is not, however, connected to the rudder chains. The wood top of the wheelhouse is finally secured to the metal base with two 6-B.A. screwed rods through the floor and roof, the nuts being countersunk into the top and filled level with plastic wood.

The engine room ventilators (Fig. 2) were a problem, but after experimenting with various metals two copper bowls were hammered out of sheet, the upright tubes being then brazed into holes made in the side of each bowl, a file completing the good work, and so far as I could see they were very near their counterpart.

Two lifebelts (Fig. 2) were made from a piece of cork mat that had given long and faithful service in the house. Suitably bound with cord and painted alternate quadrants red and white, they filled the bill nicely; racks were made with cycle spokes, threaded 10-B.A. and bolted through the wheelhouse casing.

The horn cleats were short pieces of resistance wire soldered on to countersunk heads of 6-B.A. screws and bolted through the casing where required.

(To be continued.)



The Chronicle of a Model Engineer in search of Skill and Experience

By "Cadet"

I EXPECT that, like me, you have read the experts on the subject of establishing a home workshop; if they have one thing in common it is that they all advise that in allocating space to equipment one has in hand, future acquisitions should be borne in mind so that the arrival of, say, a milling machine does not mean that the entire shop has to be pulled-from-together to accommodate it.

Realising the soundness of the advice I tried to work to these rules, with the result that there was a substantial space at the left-hand end of the main workbench mentally labelled "Lathe." I now began to find that whenever I walked in the workshop that space reproached me; it just cried out for a nice, shiny machine to be bolted to it.

But cash quite apart, any amateur will agree that buying a lathe is not an operation to be undertaken lightly. As one maker truly says, "the lathe is the heart of the home workshop" and if you boob in choosing it the rest of the equipment won't give you much consolation. So, much as that space on the workshop bench mocked me, I decided I was not going to be in any hurry to fill it.

All along I had, of course, been studying the advertisements and this had given me a pretty clear idea of the lathe I really wanted, selling, with basic equipment, at a price not too crippling for this day and age. But. . . .

This machine carries with it a very long list of optional extras; optional certainly, but the thought occurs: "If I don't have these extras, or quite a lot of them, is the machine going to be wasted because I can't get out of it the most of which it is capable?" A disturbing idea which becomes more disturbing when you add together basic cost, price of a couple of chucks, a set of lathe tools, a motor, and the "optionals" you feel you really must have. What started out as a fairly reasonable proposition has now swelled to a major project.

So you turn to a second machine, with the same 3½ in. capacity, but with much less in the way of extra equipment; it has fewer inches between centres, but the basic price is much lower. It seems attractive . . . . then you begin to wonder: "Will I ruin the motor stopping and starting, because there is no clutch? How many jobs will I get that need more between centres than the machine provides?" And so on. At this stage it begins to strike you that what you need is advice.

I went to a very worthy gent, who is one of the pillars of the S.M.E.E., and I explained my problem to him in the simple language of the inexperienced. With a grave, pontifical air he finished filling his pipe; lit up, got it drawing to his satisfaction, and then gave me his precepts: "Son, there is but one lathe. . ." and he named a make I might possibly aspire to, if I sold up everything else; stopped smoking for the rest of time, and walked to London and back every day, to save the fares.

With what I realise was great temerity, I gently pointed out that this make was what might be termed somewhat costly and my purse was slender. To this my tame Polonius replied, ah yes, verily, but I would have to buy two, or even mayhap three, cheaper lathes to cover the single lifetime of one of the make he had mentioned. This, I say with all diffidence, did not ring true; my mind went back to the frequent adverts, one sees in "Ours" for the Drummond round-bed, put up for sale after many years of faithful service and still, to all appearances, good for another decade or two of model work.

Gently, I advanced this point of view, to be told, "But they're toys, me-boy—toys." My Polonius went on to advise me that any machine which will not turn the drivers for a 10-in. locomotive with room to spare, and tear off a quarter-inch cut regardless in any material, was not to be considered seriously. At this stage I decided that my mentor was way miles above my head, thanked him, and left. But as I walked away an absolutely heretical thought crossed my mind, sponsored by some recent correspondence in THE MODEL ENGINEER. It was: If the rest of the S.M.E.E. think as does this gentleman, and they own among them a number of such super-duper lathes, then *why* is it that we do not see more new S.M.E.E. locomotives on the exhibition stands? What an impertinent thought!

Disconsolately I next decided to walk around a bit and look at some of the lathes "in the metal." One thing struck me straight away, and I expect that others have had the same experience. You see some lathe in an advert. or catalogue and think what an imposing piece of machinery it is; then you see it in the raw and murmur: "Gosh, isn't it *small*."

Another thing to strike me, was that some of the retailers must take the buyer-to-be for a very trusting fellow judging by the number of machines I saw on display either bearing the stern warning: "Do not touch," or with all movable parts lashed with

Continued from page 230, *March* 4, 1954.

wire. I do agree that the average person on seeing a handle immediately wants to turn it, regardless, and cannot resist pressing a button, which is all very bad for the machine. But what about the chap like me, who really wants to know about the lathe ?

At one place I was standing gazing rather sadly at a lashed-up demonstration machine when a very courteous salesman came up, spoke his piece and then proceeded to undo all the bits of wire so that I could turn the handles and press the levers. Which was fine, except that I felt so guilty on leaving the shop without buying his lathe, that I probably won't ever go back there again.

My tour of the shops helped, in that I narrowed the field down to three makes, but it did not help me to decide on which one of the three. Then an interested party suggested: " Why don't you consult *The " M.E."* *Lathe Manual* ? A simple, straightforward idea, I grant you, but one that had not occurred to me; I had rather regarded it as a bible to be studied once a lathe was obtained. However, I got a copy, dived in, and there found the answers.

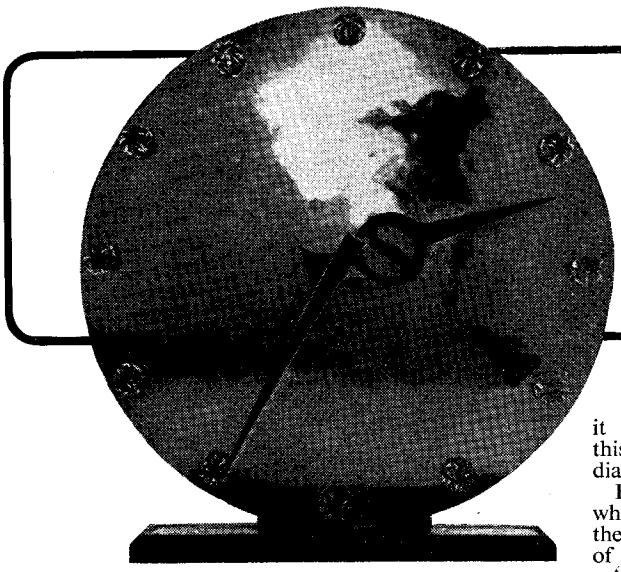
Quite early in the book, Westbury says that assuming that the buyer will have to husband his financial resources—and how right he is in his assumption—his attitude towards any elaboration in the design of lathe he is selecting should be: Is it a necessity for the kind of work I propose to do, or does it merely affect convenience, or apply to special kinds of work which I may not carry out very often ? That, in a nutshell, was the line of thought I needed. I was hankering for a lot of frills which would probably sit up on the shelf and be used a couple of times in a decade. And I was much cheered by the assurance in the manual that accuracy to that odd thou. lies more in the hands of the turner than in the perfection of the machine.

I do, however, pick one quarrel with the author; and that is when, after pointing out in rather more technical language than mine, that the unskilled one is liable to " bend " a lathe somewhat before he really knows what all the blobs and gadgets do, he goes on to say that the beginner " is therefore, well advised to start on a simple and not too pretentious type of machine." True, oh master, but this raises one or two points which seem to have escaped your consideration: Where is the cash coming from to buy two lathes, and if I do, who is going to want my " bent " one when I graduate on to the more advanced model ? And who knows anybody who is going to be silly enough to turn a beginner loose on his " simple and not too pretentious type of machine " which is doubtless the apple of his eye anyway ?

Nevertheless, I was much obliged to friend E.T.W. I became reconciled to the machine I had wanted in the first place, but without all the extras which had clouded the issue before. So be it.

I am now going to bid you farewell for a time as a " long-distance call " demands that after a lot of oiling and greasing, I should close the workshop door for a spell. So to all the novices, amateurs, beginners and seekers after skill—cheerio, and happy turning !

" *—toys, me-boy—toys* "



A Simple Electric Clock

By A. R. Turpin

THE clock about to be described is one of those rare things, a product of the home workshop which makes the wife appreciate that some things that come out of it can be useful, always provided that the said wife likes contemporary designs. It also has the added attraction that it takes very little time to make, about six hours, in fact.

The electric movement is purchased for about 30s. post free from H. Franks, 58, New Oxford Street, London, W.C.1. and is of the type originally made by the Sterling-Croydon Clock Co. Ltd. These movements have the advantage that they are of the "one hole fixing" type; being secured to the face by means of a screwed bush, which passes through a hole drilled in the centre of it and screws into a plate which is on the front of the movement. These works are protected by a brown plastic cover and this is secured to the movement by two cheese-headed screws. Because the face is domed, it is necessary to turn about $\frac{3}{16}$ in. off the length (back to front) of this cover. To do this, the cover is removed, very carefully gripped in the chuck and the necessary amount removed by taking very fine cuts across the front edge with a very sharp tool. It is far better to take off too little than too much because the case can then be drawn up tight against the face by means of the cheese-headed screws after the movement has been fixed in position by the screwed bush (see Fig. 1).

The face of the clock itself is a domed piece of 16-s.w.g. copper and the dome is formed by "raising" it from a disc of this metal $7\frac{1}{4}$ in. diameter.

For the beginner who has never tried the fascinating craft of metal raising, a short resumé of how this actual job can be done is given here.

The first thing is to make yourself a "stake," which is really a small anvil having a surface approximately the same curve as that of the domed face. A 2 in. length of $1\frac{1}{2}$ in. diameter mild-steel will do nicely for the job. Chuck the length of bar, and then using the cross- and top-slides together, turn the face roughly to the contour desired. Next, fit up some kind of hand-tool rest and then, using a broad faced tool—such as an old flat file—finish the curve as accurately as you can by eye, and at the same time round the corner well. Finish with a file and then bring to a nice polish and fix securely in the vice.

Cut out your disc of copper and mark the centre plainly with a centre pop, because you will keep needing this centre. Next, anneal your copper by bringing it to a very dull red, and then quench immediately in water, which will remove most of the scale; the remainder can be removed either by hard rubbing with a wet pad and pumice paste, or by pickling it in a bath of sulphuric acid, 20 per cent. By the way, I find an ideal receptacle for the acid is my wife's new poly-vin wash bowl. Finally, rinse the copper and dry it; we are then ready to commence "raising."

First, draw a circle with pencil compasses about $1\frac{1}{2}$ in. in from the edge of the disc, and then hold the copper over the stake so that a point on the circle is well on the stake and touching it. With the left hand holding the lower edge, firmly strike the copper just above the point of contact so that the copper is forced down on to the stake; do not hit it at the point of contact (see "raising" Fig. 2). Now rotate the disc about half-an-inch and strike it again. Keep repeating this procedure until you arrive back at the place you started at, then move up about half-an inch and continue on round in repeated circles, forming a spiral that eventually reaches the edge. The result will now look like a rather dented saucer, and will be most discouraging, but it will look even worse before it is finished. The hammering will have hardened up the copper, so we must anneal and pickle it again before proceeding. Having done so, we now mark a circle 3 in., in from the edge and proceed as before, but start on the new circle and work out spirally to the edge. This having been done, once again anneal, pickle, and repeat the dose, but this time start from the very centre of the disc.

With such a shallow dome as this, the curve should now be very roughly the shape which we want, so we can start planishing. The big difference between raising and planishing, is that with the former we are, or should be, altering the shape of the metal to the shape we finally want, and with the latter we are only trying to smooth out the dents, and even up the curve. By the way, the correct hammer to use is, of course, a raising or planishing hammer, but these cost money, and for a "one off" job, any hammer will do, provided the face is well polished and is slightly convex. I use what is sold for a shilling or two by a multiple store, as a cobbler's hammer.

When planishing, the hammer should hit the copper directly and squarely over the spot where the metal makes contact with the stake, and the blow gives out a ringing sound compared with that given when raising (see Fig. 2).

The copper having been annealed and pickled once more, concentric circles are drawn every $\frac{1}{2}$ in., from the

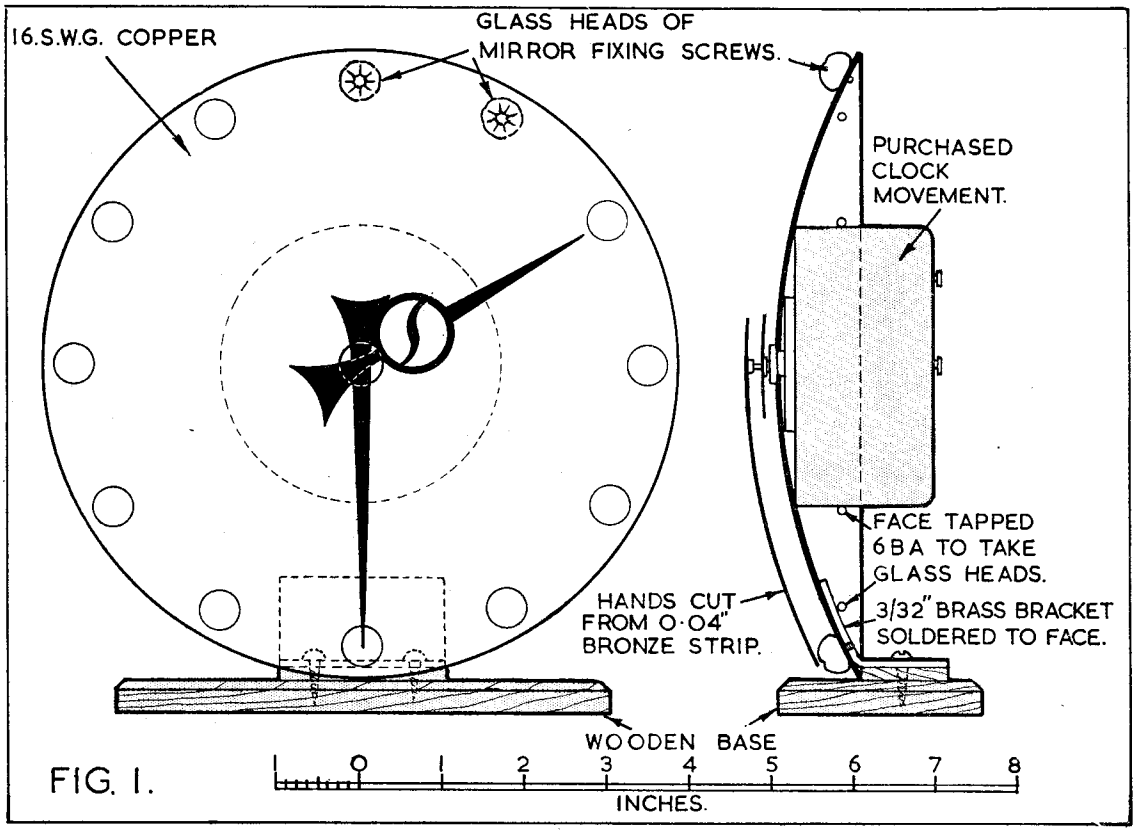
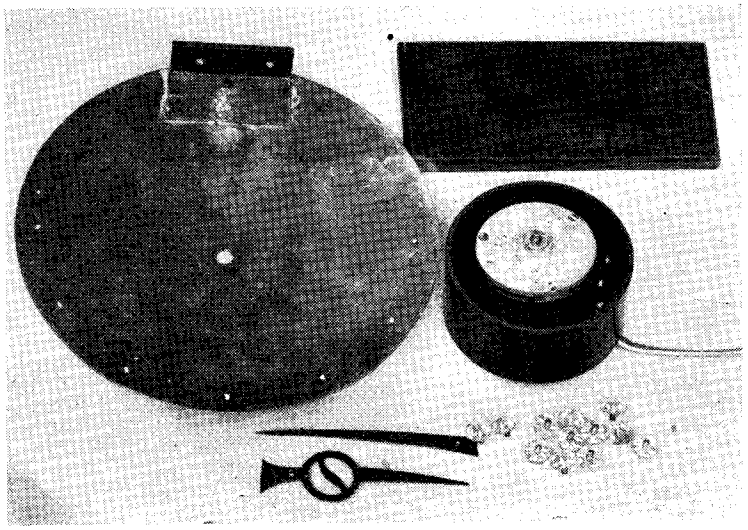

16.S.W.G. COPPER
GLASS HEADS OF MIRROR FIXING SCREWS.
PURCHASED CLOCK MOVEMENT.
FACE TAPPED 6 B A TO TAKE GLASS HEADS.
3/32" BRASS BRACKET SOLDERED TO FACE.
HANDS CUT FROM 0·04" BRONZE STRIP.
WOODEN BASE
0 1 2 3 4 5 6 7 8
INCHES.

FIG. 1.

centre to the edge of the now domed disc; starting at the centre of the disc with comparatively light blows, which will leave a bright spot behind, the copper is continually rotated about $\frac{1}{8}$ in. at a time, so that an ever-growing circle of bright facets spiral towards the edge; each facet touching its neighbour, and each circle touching the next. Thus the whole disc will be covered with a multitude of small dents that have smoothed out the larger ones; but the surface is not good enough yet, so it is given a final annealing, pickle, and another planishing, this time using still less force on the hammer, in fact, the strength should be such that you wouldn't mind putting your finger under the hammer. If you like, you can go on repeating the dose, gradually improving the surface, until your patience wears out; but do not anneal again, because we want to leave the face finally in a hardened state.

The next thing to do is to polish the face, because it will be easier to do this before the holes for the beads and bush are drilled. Use a bob dressed with 120 emery and scurf all over, or if you haven't got an emery bob, use a pad of emery cloth and elbow grease, but don't overdo this part of the process, because if you do you will polish out all the hammer marks which gives hammered copper its beauty, and will be left with a perfectly smooth and unexciting finish; just use the emery to get rid of any small blemishes



The component parts of the simple electric clock

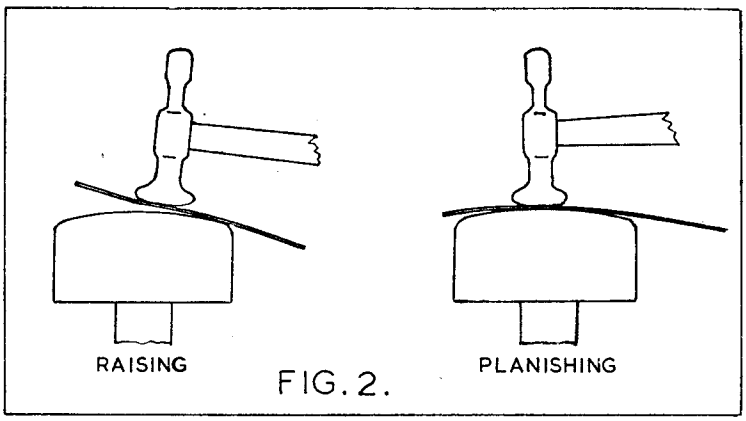


FIG. 2.

and light scratches; heavy ones should have been removed before the job was started, by using a scraper. Follow the bob with a mop dressed with tripoli compo to remove the fine scratches left by the emery, and finally finish with a swansdown mop and rouge. For doing the job by hand, use wet pumice powder and a felt pad followed by metal polish.

The drilling for the beads can now be carried out, but care must be taken not to scratch the nicely polished surface. Take a fine drill through the centre of the face from the front to the back, and then open this out to $\frac{5}{16}$ in. clear, working from the back to the front. The twelve 6 B.A. tapped holes were spaced out on the lathe, using the dividing head. The face was mounted on a length of $\frac{5}{16}$ in screwed rod, which was pushed through a collet chuck of that size. The back centre was then brought up and the tail-stock feedscrew operated so that the nut on the rod behind the face came against the face of the collet, forcing it in to its housing and making it grip the rod. Using a drilling spindle and a fine centre drill, the position for the twelve hours was just spotted; a piece of wood of suitable thickness was placed between the back of the copper dome and the faceplate of the lathe —my collets can be used with the faceplate in position—the dome was then removed, and the holes drilled on the pillar drill at right-angles to the curved copper, then tapped 6 B.A.

The brass bracket was next tackled (see Fig. 1), a piece of brass 3/32 in. thick and 2 in. × $2\frac{1}{4}$ in. square is bent along the centre of the longest way to form an angle bracket of about 110 deg., one side of which is then hammered on the stake so that it takes up the approximate curvature of the face; it is then soft-soldered on to the dome, taking care not to overheat the copper and soften it.

The glass beads used to take the place of figures on the face are actually the tops of those glass-headed screws used by cabinet makers to hold frameless mirrors in place. They are sold complete with a wood-screw, in the top of which is a 6 B.A. tapped hole, and the glass bead has a short length of 6 B.A. studding cast into it. The wood-screws are not used in this case, the beads being screwed directly into the copper face. The beads are obtainable in white and peach-coloured glass, and the latter look much better on the copper if you can get them. They cost about 6s. doz.

The hands are cut from phosphor-bronze strip about 0.04 in. thick, a piercing saw being used for this job, and finished off with a fine half-round file. The surface of the hands was then hammered lightly to give the surface an interesting texture, and at the same time harden them; this hammering was done on the stake, so that they took up the same curvature as the face.

A small disc of 18-s.w.g. brass was then soldered to the hands under the place where the arbor holes are to be drilled, and this operation was then carried out. The holes should be drilled slightly undersize, and opened out with a broach so that they are a tight push fit on their respective arbors.

The base can be of wood or plastic, whichever takes your fancy, but dark oak certainly goes well with the copper.

It only remains now to give the face a final polish, and then spray or brush on a coat of colourless lacquer to prevent it tarnishing.

ENGINEERING FILMS ON LOAN

THE Owen Organisation has recently published a catalogue describing the considerable number of films which have been produced for member companies of this large group, which, with its parent company of Rubery, Owen & Co. Ltd., Darlaston, South Staffs, comprises nearly 40 engineering firms.

The organisation offers these films on loan to societies, clubs, etc., and many would undoubtedly be of interest and value to those in our own field. All negotiations should be made with The Public Relations Office, The Owen Organisation, Kent House, Market Place, Oxford Circus, London W.1, and it would be much appreciated if as much notice as possible could be given when requesting films, in order to ensure receipt in time for any given show. Incidentally, it appears that the Owen Organisation's own cinema, at the London offices, is available for use, by special arrangement.

Two films are devoted to graphic descriptions of the methods employed in modern mass-production of motor vehicles. There are also five on the history and development of the B.R.M. racing car, which was lately taken over by the organisation, and is, of course, still under development, and indeed, very much alive, so much so that it may distinguish itself in Grand Prix racing this season.

Two other films relate to mechanical handling in industry—a subject which is not as dull as it may sound, particularly in view of the fact that the fork truck, and similar forms of materials-handling device, are subjects worthy of modelling. There is a general engineering film which describes the varied work of Rubery, Owen (Warrington) Ltd., including the manufacture of large ditching machines and road finishers, two-speed axles for commercial vehicles, and machine tools. Several films are devoted to the production and use of agricultural machinery.

A colour film is at present in production which will present the Owen Organisation as a whole, and it is hoped that this will be available during the spring.

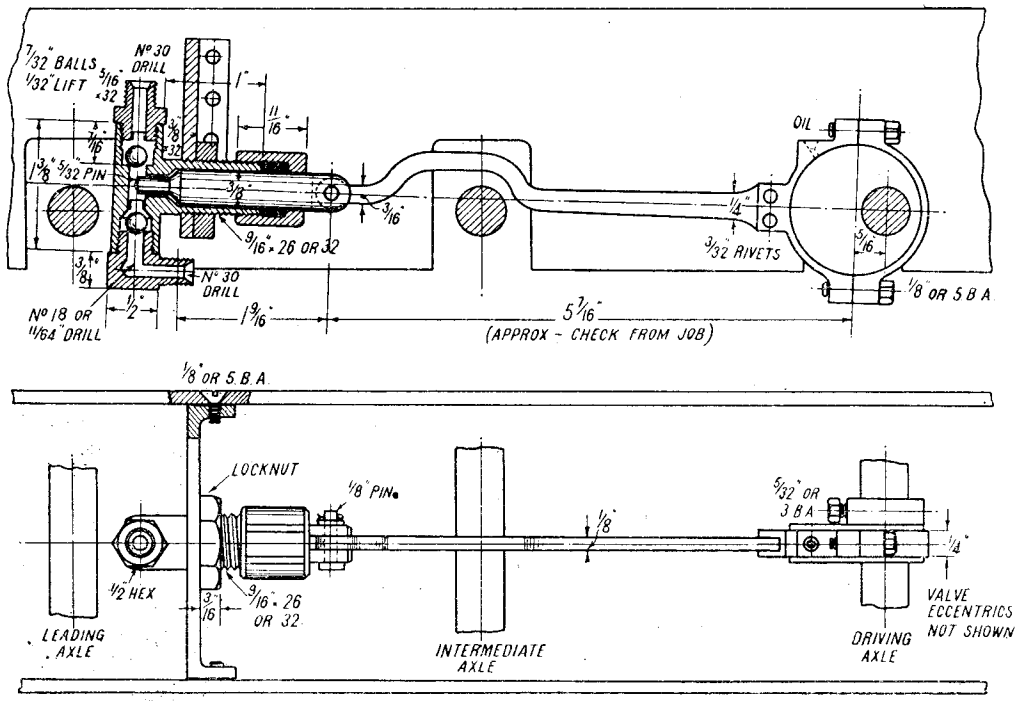
L.B.S.C.'s "Netta"

A NORTH-EASTERN T-CLASS "MITEY" HAULER IN FIVE GAUGES

AS the pump for the 3½-in. gauge engine is just a larger edition of that specified for the 2½-in. gauge quin, there is no need to detail out the whole rigmarole again; so it will be sufficient if I just call attention to the difference in sizes, and slight variations in detail. The body is made up from a casting, or rod material as before, and is machined in exactly the same way, except that the seating for the ball isn't reamed. I have found that if the seating for a 7/32-in. ball is reamed $\frac{3}{16}$ in. and the reamer happens to cut a shade large, as is sometimes the case, the ball is inclined to stick on the seating, especially when pumping against high pressure; also it will tend to "set" when the engine is out of use for a few days. I have, therefore, specified a smaller seating diameter, drilled No. 18 or 11/64 in., and if the drill doesn't cut a perfectly true hole, a slight scrape with a taper broach, will put matters right. It is surprising what a big difference just one-sixty-fourth will make.

If the usual type of bottom union is used, a very sharp bend would be needed in the feed pipe; and if the pipe be kinked or flattened in making the bend, the free flow of the feedwater will be affected. To get over this, the bottom fitting is made as shown in the illustration. This can be a casting; and if so, maybe our good friends who supply them, will arrange the casting in the form of a cross, which will make the machining of the screwed parts at right-angles, just a kiddy's practice job, as the spigot opposite the part to be machined, can be gripped in the three-jaw. Alternatively, the ball-seating section can be machined up from ½-in. hexagon rod held in the three-jaw, and the union nipple made from $\frac{5}{16}$-in. round rod, with a 5/32-in. spigot turned to fit a hole of same size, drilled in one of the facets of the hexagon. Silver-solder the joint as usual.

For extra security and strength, a locknut is fitted on the pump barrel at the back of the pump stay, as shown in both section and plan. This can be made from $\frac{7}{8}$-in. or 1-in. hexagon brass rod. The gland nut should be made from either drawn or cast bronze rod, as it acts as a guide to the pump ram.



Section and plan of pump for the 3½-in. gauge engine

The eccentric-rod can either be bent up from bar material, or cut from $\frac{1}{8}$-in. steel plate. There isn't much in it, either way, as the piece of bar would need milling or filing to the given outline, and a rod cut from plate, needs no bending to shape. Maybe friend Reeves may supply malleable cast eccentric-rods, in which case any builder who uses them is "in the clover"; all the work needed is a clean-up with a file, the hole drilled for the gudgeon-pin and the rod is ready to attach to the eccentric-strap. The dimensions of the latter are shown in the drawing, and the machining is carried out in the way I have described umpteen times already. The bore is big enough to hold on the smallest step of a 3-in. three-jaw chuck, for facing off to correct thickness.

The exact position of the pump-stay was clearly shown in the drawing of the frames, by dotted lines. If it has already been erected, take it out again, screw the pump barrel through the hole, as shown in the drawing, and put the locknut on, taking care to set the pump with the valve-box vertical, and not leaning over to either side. By the way, a dimensioning error somehow crept into the illustration of the pump-stay; the diameter of the tapped hole is $\frac{9}{16}$ in. instead of the 9/32 in. shown, but this was obvious, as the drawing was correct. The stay can then be replaced, and the pump ram connected to the eccentric rod, either by the kind of pin shown, or by a piece of $\frac{1}{8}$-in. round steel, reduced to 3/32 in. diameter at each end, screwed 3/32 in. or 7 B.A., and furnished with commercial nuts to suit. There should be approximately 1/32 in. clearance between the ends of pump ram and barrel, when the eccentric is on front dead centre, in the position shown; I have explained how to get this, quite a number of times, so needn't repeat the details here. If the plain pin is used, turn it from $\frac{1}{4}$ in. round steel, drill the hole for the split-pin with No. 55 drill, and make the split-pin from a bit of thin brass wire, with half the diameter filed away. Don't forget to put a $\frac{1}{8}$-in. washer between ram and split-pin.

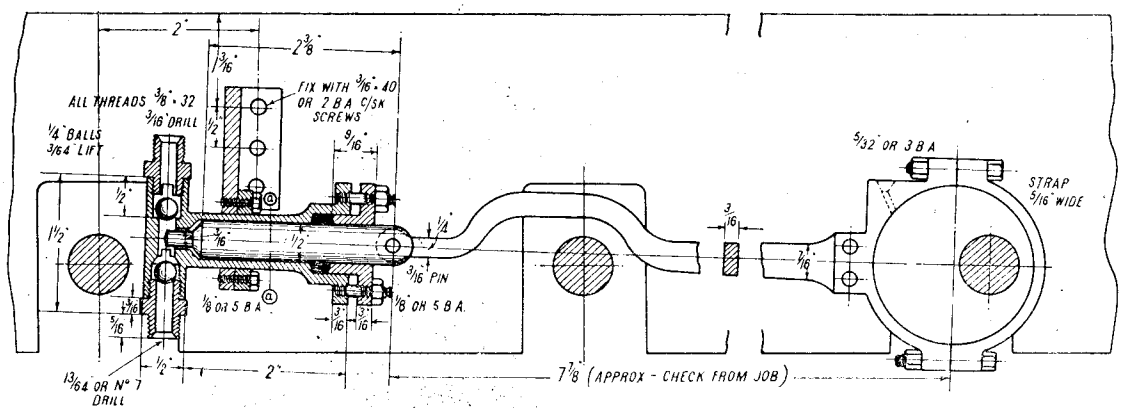
Beginners have written from time to time, to ask if there is any special way in which the eccentric of a pump should be set, in relation to the cranks, as they have heard it stated that in certain positions, the resistance of the pump will cause the engine to "kick" when running slowly with the regulator almost closed. The cylinder power of my engines is usually great enough to overcome this tendency, and I've never experienced it with any of my own stud; but our old nighthorse Inspector Meticulous agrees that the best "calculated" position would be midway between the two main cranks, so that the forcing stroke of the pump gets the full benefit of the maximum thrust of both pistons.

Pump for 5-in. Gauge Engine

The pump for the big quin differs from the smaller ones, inasmuch as it is getting on towards full-size practice; or rather, what would be full-size practice if the big engines had pumps. It has a studded gland of the same type as fitted to the crosshead pumps of the Stroudley engines of the L.B. & S.C.Ry.—I should know what *they* looked like, having packed plenty of them!—and the complete pump is attached to the pump stay, by aid of a hefty square flange on the barrel, near the middle of its length. If a casting is used for the pump barrel and valve-box, which I recommend, this flange will be cast integral. Might I give our approved advertisers a tip at this point: viz., to make sure that the chucking-piece on the valve-box, opposite the barrel, is hefty enough to support the casting while the flange is being faced on the contact side.

The actual machining isn't so very much different from that for the pumps previously described; but to make certain nobody slips up, I'll run briefly through it. Chuck one end of the valve-box in the three-jaw and set the other end to run truly; you'll have to "wangle" it so that the barrel and flange squeeze in as much as possible between the chuck jaws, and keep your fingers out of the way when they are buzzing around, or some sticking-plaster will be called for, if nothing worse. Face, centre, and drill right through with 13/64-in. or No. 7 drill; open out and bottom to $\frac{1}{2}$ in. depth with 11/32-in. drill and D-bit, slightly countersink the top, and tap $\frac{3}{8}$ in. × 32 or 40. Re-chuck the other way around, on a stub mandrel with a screwed nose, held in the three-jaw, and repeat operations on the other end, except that the D-bit needn't be used; nick the end of the hole instead.

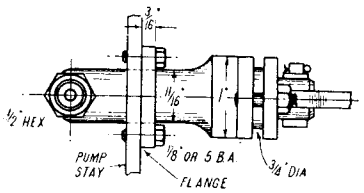
The next bit is where the process differs from the previously-described pumps, so watch your step. Grip the casting in the three-jaw, by the chucking-piece opposite the barrel, and set the barrel to run as truly as possible, before tightening the chuck. With a size "E" centre-drill, held in the tailstock chuck, make a fairly deep centre in the face of the oval flange at the end of the barrel. Replace the tailstock chuck by the centre-point, and run up the tailstock until you can enter the centre-point into the hole, leaving enough room to manipulate the slide-rest. This is a piece of cake on my "supersonic" Myford, the tailstock of which is a real Bill-Massive streamlined job,



Pump for the 5-in. gauge engine

with a barrel which can be extended full length without "wobblisation" setting in; most tailstock castings are too short. With the barrel of the pump thus supported by the tailstock centre, it will be an easy job to face the contact side of the flange with a left-hand knife-tool, and turn the outside of the barrel, right up to the oval flange, if the casting is at all rough, and you so desire. Then, with a right-hand knife-tool, face off the flange itself, as near as you can get to the centre-point; finally, push the tailstock away, and very carefully face off the weeny bit of "rough" around the centre-hole.

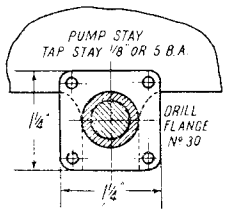
Replace tailstock chuck, and with a 7/32-in. or No. 2 drill in it, drill right through the barrel until the drill breaks into the hole in the middle of the valve-box. Open out with $\frac{1}{2}$-in. drill for $1\frac{7}{8}$ in. depth, and be very careful indeed how you start the drill, as it will run out of truth, and chatter, on the slightest provocation, if the lathe bearings are the least bit slack, or the machine itself flimsy. The best "insurance" for beginners and inexperienced workers, is to set up a boring-tool in the slide-rest, and bore out the end of the barrel, same as boring a cylinder, for about $\frac{1}{4}$ in. or so in depth, until the business end of the drill will just enter without shake; this will give it a true start, which will guide it to destination. Better take a little extra trouble, than spoil the casting, or have an untrue hole which will cause the pump ram to run with excessive friction. Then bore out the end of the barrel, to $\frac{3}{4}$ in.



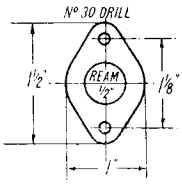
Plan of pump (5-in. gauge)

diameter, for a full $\frac{3}{8}$ in. depth, with a boring-tool as above, and take a very fine skim off the face of the flange, to remove any burring.

Remove from chuck, and saw off the chucking-piece, filing the stub right away and leaving the valve-box rounded. Put the 13/64-in. or No. 7 drill through the centre part, to clean out any burrs, then enter a taper broach down the D-bitted end, and take a slight scrape out of the end of the hole, to true the seating for the ball. The union fitting for the top of the valve-box, and the bottom fitting, with the seating for the inlet-valve ball, are then made and fitted exactly as described for the $2\frac{1}{2}$-in. gauge pump, but working to the dimensions shown in the accompanying illustration.



Section of pump on (a) (a)



Flange of pump gland

The gland should be made from a casting, which is chucked in the four-jaw with the boss outwards, and set to run truly. Face off the end of the boss, centre, drill right through with a $\frac{3}{16}$-in. drill, open out to 31/64 in. and finish with $\frac{1}{2}$-in. parallel reamer. Face the flange, and turn down the boss to a nice sliding fit in the enlarged end of the pump barrel. Slightly countersink the end, as shown in the sectional illustration. The outside of the oval flange can then be faced truly; then scribe a line exactly down the centre, and on this line, exactly $\frac{9}{16}$ in. above and below the centre of the $\frac{1}{2}$-in. hole, make two centre-pops. Drill these out with No. 30 drill, making sure that the holes go through dead square with the flange. Push the gland right home in the stuffing-box in the pump barrel, and line up the flanges. Poke the No. 30 drill through the holes in the outer flange, and make countersinks on the face of the inner one. Remove the gland, drill out the countersinks with No. 40 drill, tap $\frac{1}{8}$ in. or 5 B.A., and screw in two studs made from phosphor-bronze or rustless steel rod, as shown in the illustration. These should be a full $\frac{3}{4}$ in. overall length. Ordinary commercial brass nuts will be all right for holding the gland.

The pump ram is made in the same way as the other sizes, from a piece of $\frac{1}{2}$-in. round bronze or rustless steel rod a full 3 in. long. One end is slotted $\frac{3}{16}$ in. wide for $\frac{1}{2}$ in. depth, to take the end of the eccentric-rod, and cross-drilled $\frac{3}{16}$ in. clearing, using No. 12 drill, for the gudgeon-pin. The other end is turned down to $\frac{3}{16}$ in. diameter for $\frac{5}{16}$ in. length, to form the anti-airlock pin. It used to make me smile when reading some of the dissertations of old-time designers, that axle-driven pumps were never satisfactory, owing to air-locking and other troubles. All I did, was to add a pin which pushed out the trapped air, and any other troubles, real or imaginary, along with it; and if any of my engines stand for a long period between runs, I just give the valve-box a gentle crack with a small lead or other soft-metal hammer, in case the balls have "set," and the pump never fails to deliver as soon as required.

The pump can now be assembled, as shown in the section, packing the gland with a few strands of unravelled full-size hydraulic pump packing, or failing that, graphited yarn. Drill four No. 30 holes in the corners of the fixing flange; take out the pump stay, if it has already been erected, and push the pump barrel up into the jaws, as shown in the detail sketch. Make sure that the pump is the right way up, with the D-bitted ball-seating at the top—mistakes are made more easily than most folk would imagine!—then attach the flange to the pump stay with four $\frac{1}{8}$-in. or 5-B.A. hexagon-headed screws, as shown. The pump stay can then be replaced, and fixed by six $\frac{3}{16}$-in. × 40 countersunk screws, or 2-B.A. screws, as desired. They may either run through clearing holes in the frame, into tapped holes in the flanges of the stay, with lock-nuts inside, or through clearing holes in both frame and flanges, with full nuts inside.

The eccentric strap and rod are merely a glorified edition of those already described, so nothing need be added to the instructions that have already been given. All dimensions are given on the drawing. Next stage, cylinders. Now, will readers please note that it is a physical impossibility for me to give advance information direct by post. I'm quite aware that the smaller quins are easier and quicker to build; but unless components are described together, I can't guarantee results.

Model Power Boat News

Ralph Richards, of the Philadelphia M.P.B.C., with his record-breaking 10 c.c. McCoy-engined boat

ACTIVITIES IN THE U.S.A.

IN my last article, I mentioned that Mr. Robert Graham of the New York M.P.B.C. had sent a lot of information about model speed boat activities in America, and I feel sure that readers will find much to interest them in the following details. Unfortunately, space does not permit the publication in full of all the material, but I have selected some of the most interesting matter, which throws much light on the activities of our American colleagues.

In addition to the written material, Mr. Graham has sent some excellent photographs, several of which appear with this article, and it is hoped to show some more of these in a later issue of this journal.

From time to time, accounts have been heard of very high speeds being attained in America by circular-course racing boats, and the speeds that are claimed as world records are certainly higher than the best so far achieved by British enthusiasts. It should be noted that the classification of racing boats differs slightly from that adopted by the M.P.B.A. For example, we have no equivalent of their "A" class, which allows an unlimited cylinder capacity for i.c. engines, provided that the all-on weight is under 16 lb.

Here is the list of records with American classifications, as recognised, January, 1954:

Class "A" steam: Michael Succarde (Detroit): 68.18 m.p.h.

Class "A" over 30 c.c., Max Biederman (New York): 69.58 m.p.h.

Class "B" 30 c.c., Charles Watkins (Chicago): 81.81 m.p.h.

Class "C" 15 c.c., Walt MacWilliams (Philadelphia): 75.00 m.p.h.

Class "D" 10 c.c., Robert Palmer (Chicago): 78.94 m.p.h.

Class "E" 10 c.c. Stock, Ralph Richards (Philadelphia): 84.5 m.p.h.

Class "F" 5 c.c., Chas. Baxman (Detroit): 63.82 m.p.h.

These records were set up during normal racing at recognised events, and the distance covered was ½ mile in each case. Four laps on a 52 ft. 6 in. radius give this distance, and it is the standard for circular-course races.

Referring again to the classification, the "E" class corresponds roughly to our "C" Restricted, except that the engines must not be modified in any way. The present record holder uses a stock McCoy "60" engine. Of the other classes, some of the engines are home-built throughout, and others are rebuilt or modified engines of commercial origin.

The 15 c.c. record holder uses a rebuilt Dooling "61" bored out to accommodate a new piston and liner. The "over 30" and 30 c.c. engines are home-built, and the photographs show some details fairly well. The "over 30" engine shown uses twin exhausts and a form of barrel throttle. This engine is of pleasing design, and the workmanship looks first class. The 30 c.c. engine is of similar appearance to some of those seen in this country. It has a bore of 1.4 in. and stroke of 1.87 in. The rotary valve timing is as follows: Open at 15 deg. past b.d.c., and close at 45 deg. past t.d.c. The exhaust ports open at 98 deg. past t.d.c., and the transfer ports at 112 deg.

A very interesting feature of this engine is the large annulus interposed between the venturi tube and the rotary valve.

It will be remembered that E. T. Westbury's "Atom V" design employed this feature and the idea is to smooth out the induction pulses of fuel-air mixture.

The sole representative of steam, built by M. Succarde, is extremely interesting. It is powered by a twin-cylinder engine with water-cooled valve-chest, and a type of semi-flash boiler, working pressure 600 lb. per sq. in. There are some good photographs of this boat and power plant, and I will arrange to reproduce them in a later issue with some further comments.

The hulls are all constructed by the owners, and to judge by the photographs are very nicely built. The Class "C" record holder illustrated, is built to a design of Harry Traband of the Philadelphia club. None of the hulls appears to be much more than 10 in. maximum beam, even in the case of the larger boats. In some cases, streamlining is employed, so that only the cylinder-head is visible above decks.

There seem to be no four-stroke engines represented among the record holders, and except in two cases, glow-plug ignition is used. The exceptions are the Class "B" (30 c.c.) and "D" (10 c.c.) record holders, in which coil and battery ignition is favoured. Needless to say, surface propellers are used in

every case and, as far as can be ascertained from the photographs, are similar in size and pitch to those used by various British exponents.

Power Boat Clubs and Regattas

One of the organisations controlling model speed boat events in America is the International M.P.B.A., a body which has been formed since the war. I do not know whether it has superseded the M.P.B.A. of America, which controlled events in the past.

The I.M.P.B.A. is composed of the following clubs: Baltimore, Chicago, Detroit, Philadelphia, New York, St. Louis, Los Angeles (all in U.S.A.); Toronto, (Canada), Geneva, (Switzerland), Durban (Natal) and Johannesburg (S. Africa).

During the course of the season, there is a number of official regattas held, including international events, where Canadian enthusiasts also take part. At the International Regatta held in Detroit on July 4-5th of last year, the total entry was some 40 boats. In several of the races at this regatta, very high speeds were achieved by the place winners. Here are the results of the racing on the first day of the regatta.

(Above): The Class " A " engine by Max Biederman (New York)

(Left): Components of the Class " B " engine by Charles Watkins (Chicago)

Class " A "

(1) B. Kaufman (Philadelphia): 56.25 m.p.h.

(2) R. Matthew (Chicago): 51.13 m.p.h.

Class " B "

(1) A. Watkins (Chicago): 73.17 m.p.h.

(2) W. MacWilliams (Philadelphia): 58.82 m.p.h.

(3) R. Palmer (Chicago): 48.06 m.p.h.

Class " C "

(1) R. Palmer (Chicago): 68.18 m.p.h.

(2) M. MacGregor (Toronto): 66.01 m.p.h.

(3) R. Graham (New York): 60.4 m.p.h.

Class " D "

(1) B. King (Toronto): 74.38 m.p.h.

(2) A Chiavirini (Detroit): 73.77 m.p.h.

(3) M. Shears (Toronto): 72.87 m.p.h.

Class " E "

(1) E. Chiavirini (Detroit): 72.00 m.p.h.

(2) W. MacWilliams (Philadelphia): 70.02 m.p.h.

(3) R. Graham (New York): 64.88 m.p.h.

On the second day, the 18 fastest boats were raced irrespective of class and this resulted in five place speeds of over 70 m.p.h., with a winning speed of 76.27 m.p.h.

The speeds at the other regattas are not always quite so high as in international racing, but 70 m.p.h. is generally attained by at least one of the class winners during a normal regatta. Here are the winning speeds at two of the inter-club events:

Philadelphia, May 24th, Class " A," Max Biederman (N. York), 59.25 m.p.h.; Class " B " Max Biederman, 71.5 m.p.h.; Class " C " Max Biederman, 57.25; Class " D " W. MacWilliams (Philadelphia), 68.75 m.p.h.; Class " E " R. Graham (N. York), 64.5 m.p.h.

Baltimore, September; Class " A " Max Biederman (N. York), 64.29 m.p.h.; Class " B " W. MacWilliams (Philadelphia), 56.25; Class " C " W. MacWilliams (Philadelphia), 75 m.p.h. (new record); Class " D "

Walt. MacWilliams of Philadelphia with his 15 c.c. (rebuilt oversize Dooling) boat, also a record-breaker in its class

Ray Seavey (Philadelphia), 69.23 m.p.h.; Class "E" R. Graham (N. York), 64.29 m.p.h.

I have selected these two regattas as showing a fair variation of the winning speeds. At the International Regatta held in Toronto, Canada on August 22-23rd, speeds were very high, and a new Class "E" record of 84.5 m.p.h. was established, while the Class "D" record of 78.94 m.p.h. was equalled.

Racing Rules

The racing rules of the I.M.P.B.A. do not differ greatly from our competition rules. For example: "The method used for propulsion shall be of a type that functions by contact with the water," and "air-screws and inertia devices such as rockets are prohibited." The bridle length is 48 in. long, the same length as used here. One difference in the rules appertaining to the circular course is that a high line position is used, the distance allowed is 30-36 in. at the pole.

Timing is by electrical timing device, or by a minimum of three stop-watches; if a record run is timed by stop-watches, they must agree within 3/10 sec. or the run declared void.

The maximum time allowed for engine starting is 5 min., and this is designated "line time." If a competitor exceeds this, it is counted as a run, and is recorded as N.T. (No Time). If a competitor's engine is running at the expiration of this time limit he is permitted to launch the boat.

I hope that the publication of this material so kindly sent by Bob Graham, will stimulate the speed boat fraternity.

The records, although high, are not unbeatable, and offer a challenge which should be all to the good for creating interest (or should I say even more interest?) in the racing of model hydroplanes.

I would not be surprised to find the longer radius course used in the U.S.A. is potentially faster. Several of the present British records have been established on the Continent, where the lap distance is 100 metres instead of our 100 yards, and there is no doubt that the pull due to centrifugal force is high. Whether or not this pull has any considerable effect on speed is a matter that might repay investigation.

The regatta season will soon be on us, and I am waiting with much interest to see if we can reach the target set by our American colleagues,

THE MODEL POWER BOAT ASSOCIATION
(Regatta List for 1954)

May 16th, S. London M.E.S. at Brockwell Park, London, S.W. (R.C.)

May 23rd, St. Albans & Dist. M.E.S. & N. London S.M.E. at Verulamium, St. Albans.

May 30th, Forest Gate M.P.B. & E.S. at Victoria Park, Hackney, E.9 (S.R.).

June 5th, Welling & Dist. M.E.S. at Belvedere Recreation Ground (S.R.).

June 7th, Bournville M.Y. & P.B.C. at the Valley Pool, Bournville Lane, Birmingham.

June 12th, St. Albans & Dist. M.E.S. at Verulamium, St. Albans, (S.R.).

June 13th, M.P.B.A. National Speed Regatta at Verulamium, St. Albans.

June 20th, Wallasey M.P.B. & Y.C. at Central Park, Wallasey.

June 20th, M.P.B.A. Regatta for Radio Controlled boats at Victoria Park, Hackney, E.9.

June 27th, Orpington M.E.S. at Victoria Park, Hackney, E.9.

July 4th, Wicksteed M.Y. & P.B.C. at Wicksteed Park, Kettering.

July 4th, Bromley M.P.C. at Whitehall Recreation Ground, Bromley Kent, (R.C., S.R. and D Class).

July 11th, Southend M.P.B.C. at Southchurch Park, Southend-on-Sea.

July 18th, S. London M.E.S. at Brockwell Park, London, S.W.

July 25th, Victoria M.S.C. at Victoria Park, Hackney, E.9.

August 8th, Bedford M.E.S. at Longholme Lake, Bedford (provisionally).

August 15th, Southampton & Dist. M.E.S. at the Ornamental Lake, Southampton Common.

August 29th, M.P.B.A. Grand Regatta at Victoria Park, Hackney, E.9.

Sept. 5th, West London M.P.B.A. at the Round Pond, Kensington Gardens (S.R.).

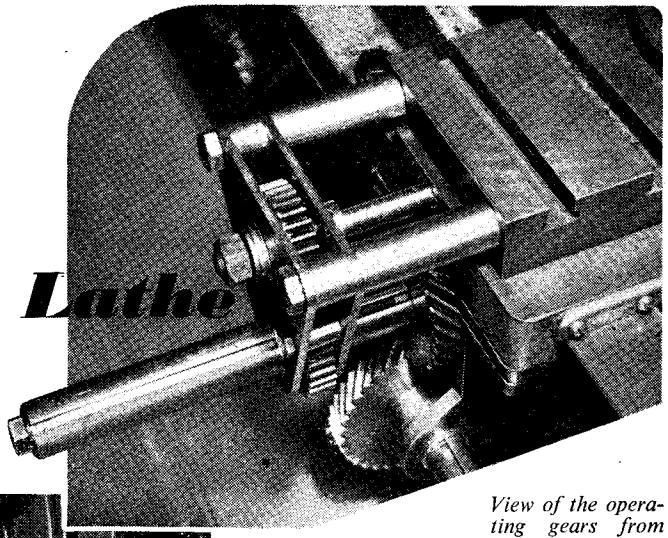
Sept. 12th, Kingsmere M.P.B.C. at Brockwell Park, London, S.W.

Sept. 19th, Blackheath M.P.B.C. at Princess of Wales Pond, Blackheath, S.E.3.

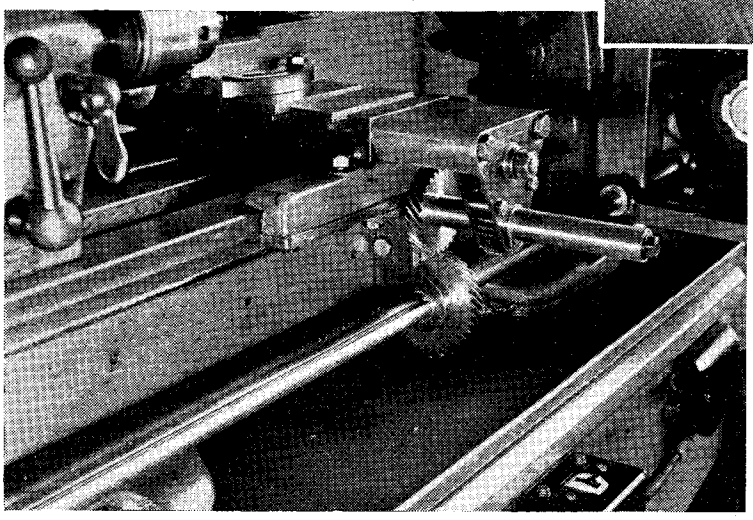
S.R.—Straight running boats only.
R.C.—Radio controlled boats only.

An Automatic Cross-feed for the M.L.7. Lathe

By R. H. Pilcher



View of the operating gears from headstock end



The gears viewed from tailstock end

IF there is one thing that I thoroughly dislike in working a lathe, it is the horrible business of turning a fiddling little handle very slowly and with great steadiness, in order to obtain a good surface finish.

I am happily the possessor of an M.L.7 lathe, but unhappily this lathe does not provide the facility of an automatic cross-feed, so I decided that, if it were at all possible, such a feed should be fitted to my lathe.

Some months ago an excellent article appeared in THE MODEL ENGINEER, describing the fitting of an automatic cross-feed to lathes, in which the cross-feed screw does not move axially in relation to the bed. The problem here is fairly simple, but where the cross-feed screw moves across the bed with the cross-slide, as in the case of the M.L.7 lathe, the problem is not quite so easy of solution.

It seemed that the best way would be to provide a feed from behind the lathe and, on looking at the job, it occurred to me that the trunnion bearings of the motor platform might be quite easily used, with slight modification, for the main bearings of a keywayed shaft, which would drive the cross-feed screw from the back.

I made a few measurements and found that the centre of the motor platform trunnion was almost exactly 2½-in., measured vertically, below the bottom of the steel gib-strip which retains the saddle in position on the back ways, and just about $\frac{5}{16}$ in., measured horizontally, from the back edge of this strip (this is shown in Fig. 1). It occurred to me that a pair of right-angle spiral gears, arranged at 2¼-in. centres, would give exactly the drive I required, allowing for the thickness ($\frac{1}{4}$ in.) of the steel strip I intended to bolt up under the gib, to support the quill.

I did not think I was capable of making such a pair of gears, so I made enquiries from one of the advertisers in THE MODEL ENGINEER, who specialises in spiral and other gears, and found that they could produce for me a pair of right-angle spiral gears in the ratio of 10 to 8, having 20-d.p. teeth, the one having 35 teeth and a pitch diameter of 2.475 in., and the other having 28 teeth and a pitch diameter of 1.980 in. This gave a between-shaft centre measurement of 2.227 in., which is very nearly the 2¼ in. I was aiming at. I put a pair of these gears on order therefore, the larger in mild steel having a boss, and the smaller being a plain wheel in phosphor-bronze. Both were $\frac{3}{8}$ in. thick. Incidentally, I chose right-handed spiral gears, as this would give me a clockwise feed to the cross-slide, when the tumbler reverse was set for a clockwise feed to the lead-screw.

Feed-shaft Bearing

Having got this far I was committed to the job and set about mounting the longitudinal feed-shaft. When I came to it this was much simpler than I had expected, and I found, on dismounting the motor platform and the countershaft support, that it was not a difficult job to enlarge the holes, which were then $\frac{1}{2}$ in. diameter, to $\frac{3}{4}$ in. diameter, by means of a spot facing cutter, but in this case I made the cutter up with a $\frac{1}{2}$-in. arbor and made my "spot faces" the full depth of the lugs in all four cases, cutting them clean through. This resulted in absolutely concentric boring without the use of a machine.

In passing, it should be noted that the motor platform and the

counter-shaft supports are both cast in aluminium, and caused no difficulty whatever in the hand-cutting process described above. Tip: In enlarging the holes, treat all four in turn, but do not quite break through. This retains the concentric support for the cutter arbor until the very end, and the last 1/32 in. or so can easily be broken out at the completion of the operation.

I then managed to obtain (more by luck than good judgment) a pair of $\frac{5}{8}$ in. bore by $\frac{3}{4}$ in. outside diameter Oilite bushes, and one of these was pressed into each of the motor platform lugs and subsequently each was permanently secured with a small Allen grub-screw, so that the motor platform could now be mounted on the countershaft support by means only of the bushes, by entering the platform from the right and passing it to the left (as viewed from the front of the lathe), the holes in the countershaft support being slightly enlarged, so that the bushes were an easy fit.

Feed-shaft

The shaft was next tackled, but it was found to be impracticable to cut such a long keyway myself on my own lathe, so that I got a local firm of engineers to do this for me (and they did it for a very moderate sum), the shaft, of course, being $\frac{5}{8}$ in. diameter, the same size as the leadscrew and, therefore, a convenient fit for all the standard change wheels. Two collars, secured by Allen grub-screws, were fitted for endwise location of the shaft. This shaft provided the drive for the larger of the two spiral gears (that having 35 teeth) and the next problem was the mounting of the smaller (28-tooth) spiral gear.

In passing, I chose the ratio of 10 to 8 for these gears for the following reason: The leadscrew of the M.L.7 lathe has eight threads to the inch and the cross-feed screw has 10 threads to the inch. It occurred to me, therefore, that since the main driving shaft at the back of the lathe was to be driven from the train of gears used for screw-cutting, it might conceivably be handy if the cross-feed obtained was exactly the same as the longitudinal feed that would be obtained from the same gear set-up. Maybe this is a small point, but it is one that did influence the design of the attachment.

Travelling Bracket

It will be noted, on examination of the lathe, that the back gib strip which holds the saddle down on the rear side of the lathe is fixed to the saddle by three hexagon-headed set-screws. It seemed to me that the left-hand two of these, viewed from the front, would do well for mounting a bracket which would carry the 35-tooth spiral gear backwards and forwards along its shaft and would, at the same time, act as an outboard bearing for this shaft at exactly the point where it was required to drive the smaller spiral gear. I cut, therefore, a strip of mild steel (*A* in Fig. 1) 4 in. long by $\frac{1}{4}$ in. thick and 1 in. wide, which would bridge these two screws, but the holes for them were not yet drilled, for the reasons described later. To this strip were fixed two "ears" (*B* in Fig. 1), made of $\frac{1}{4}$-in. plate and screwed to the strip with 2-B.A. countersunk screws. Had I had access to welding equipment no doubt this would have been a better way, but since I had not, I used the screws and they seemed to work quite satisfactorily, though some stiffening was necessary, as I found later, and to accomplish this a block of steel (*C* in Fig. 1) $\frac{1}{2}$ in. thick, deep enough just to miss the 35-tooth wheel when chamfered off, as shown in Fig. 1 at *D*, and of a width equal to the width of the 35-tooth wheel, plus its boss, plus $\frac{1}{8}$ in. (to allow for two $\frac{1}{16}$-in. bush flanges) was secured between the ears by means of two $\frac{1}{4}$-in. B.S.F. set-screws, and to the bar by a couple of 2-B.A. countersunk screws. This made the whole thing very secure and no trouble has been experienced at all, as a result of lack of rigidity.

Between the two ears described above, a $6\frac{1}{2}$ in. length of $\frac{1}{2}$ in. round mild-steel was fixed, half its diameter being milled away at one end for a distance of 1 in. (see *E* in Fig. 2), so that it could mate up with the steel strip *A*. This again was secured by 2-B.A. countersunk screws and the rod was turned to the diameters shown in Fig. 2. The dimensions were chosen not quite arbitrarily, but in order to give stiffness, there being a comparatively large bearing at the root end, an oil void in the centre part of the length (shown at *F*) and a smaller bearing at the outboard end. In both cases Oilite bushes, *G*, were used, at the larger end $\frac{1}{2}$ in. outside diameter,

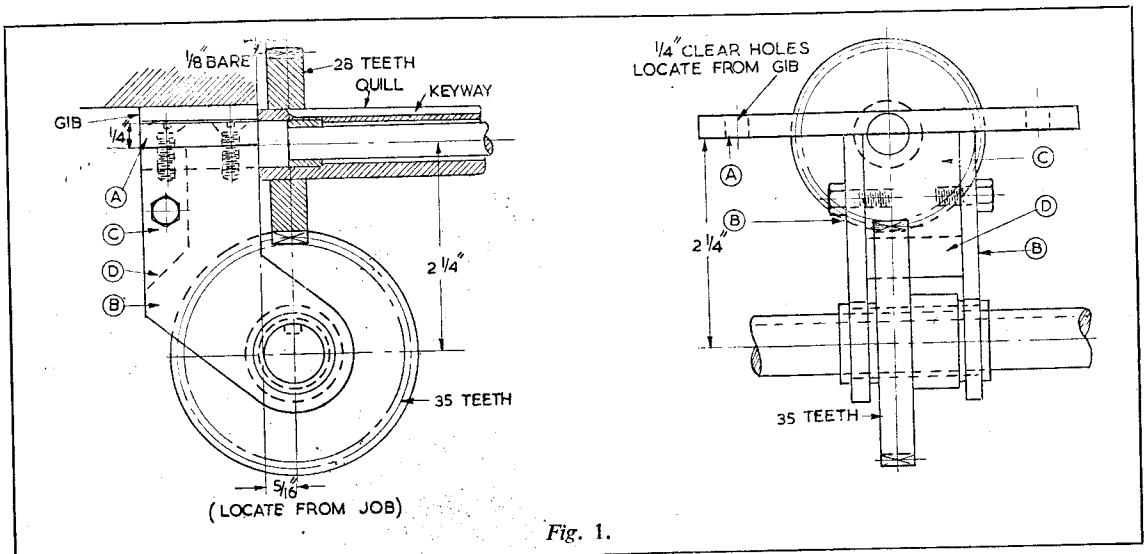


Fig. 1.

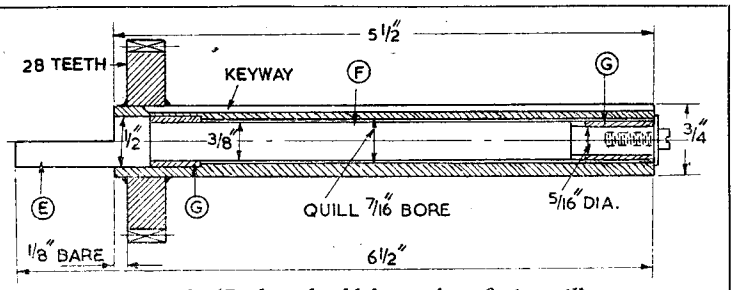


Fig. 2. (Bushes should be a close fit in quill)

$\frac{3}{8}$ in. bore, and at the outboard end $\frac{7}{16}$ in. outside diameter, $\frac{5}{16}$ in. bore.

The Quill

These bushes were pressed into a $\frac{3}{4}$ in. outside diameter sleeve, bored as shown in Fig. 2. One advantage of this construction is that the longish hole can be drilled from both ends, so that any slight inaccuracy in the meeting in the middle of the two drillings has little or no effect, there being ample radial clearance in the space between the two bushes.

A $\frac{1}{8}$ in. by $\frac{1}{8}$ in. keyway was cut on the outside of the sleeve, nearly to the inboard end, but "running out" at the outboard end, and it will be noted that this keyway actually goes to such a depth that it exposes the inboard bush, and this is shown in one of the photographs.

Finally, the 28-tooth bronze wheel was sweated in position near the inboard end of the sleeve or quill, as it was considered that this method provided ample strength without the necessity of fitting keys or other fixings.

Extension Shaft

It was necessary now to provide a feed from the quill, driven by the spiral gears, to the cross-feed screw. On investigation I found that this feedscrew is $\frac{3}{8}$ in. in diameter and it was necessary to extend this $\frac{3}{8}$ in. screw through the back of the saddle for some distance. Accordingly I drilled a hole in the back end of the dovetail which is machined on the saddle, this hole being exactly opposite to, and parallel with, the hole at the front which houses the cross-feed nut. This was not too difficult by the method which I adopted, which was to drill the hole as nearly as possible in the correct position by measurement, and subsequently to ream it out from the front, using a $\frac{3}{8}$ in. expanding reamer mounted in an extension rod, passed through the front of the saddle.

In passing, it is worth while perhaps to mention that this method of extending a reamer is very often useful, and it is easily and accurately accomplished if the extension rod is first truly drilled to a light push fit on the shank of the reamer to a depth of about an inch, and subsequently drilled a little deeper with a drill perhaps 1/64 in. smaller, in which case the reamer can be easily driven into the hole—using, of course a piece of hardwood for protection—and the corners of the square will then bite into the smaller diameter, effectively preventing turning, but not preventing fairly easy extraction of the reamer after the operation is completed. The accurate fit on the parallel part of the reamer leads to quite accurate alignment in a job of this sort. The extension-rod should, of course, be made a good fit in the guide hole, in this case the housing for the nut of the feedscrew.

The next job to tackle was the extension to the cross-feed screw, and this was made from a piece of $\frac{1}{2}$-in. mild-steel rod, having at one end a hole drilled about $\frac{5}{8}$ in. deep, and just less than $\frac{3}{8}$ in. diameter, this to be a tight driving fit on the end of the feedscrew itself. The total length of this extension shaft was 8 in., and $7\frac{1}{4}$ in. of this was turned down to $\frac{3}{8}$ in. diameter to fit the hole just reamed in the saddle, and the last $\frac{1}{2}$ in. or so was threaded $\frac{3}{8}$ in. B.S.F. This is shown in Fig. 3.

Gearbox

The "gearbox," which can be seen plainly in the photographs, was quite a simple job and contained merely two gears, each of 30 teeth, 20 d.p., taken from the standard set of change wheels supplied with the Myford lathe. The topmost wheel—that mounted on the extension shaft just described—was truly mounted in the lathe, and counterbored for about three-quarters of its thickness to a diameter of about $1\frac{1}{8}$ in., as shown at *H* in Fig. 3, and a mild-steel spigot, *J*, was fitted to it and riveted in before being bored through $\frac{3}{8}$ in. diameter to suit the extension shaft, and turned $\frac{3}{4}$ in. o.d. to run in the $\frac{3}{4}$ in. bush in the frame plate. Into the recess was fitted a disc of Ferodo, *L*, taken from a motor cycle steering damper, and engaging with this disc was a mild-steel "clutch plate" (shown in the sketch at *K*), this fitting being secured permanently to the extension shaft by means of an Allen grub-screw put right through the boss and the shaft. The spigot, *J*, was of such a length that it would reach outside the "frames" of the

(*Continued on page* 447).

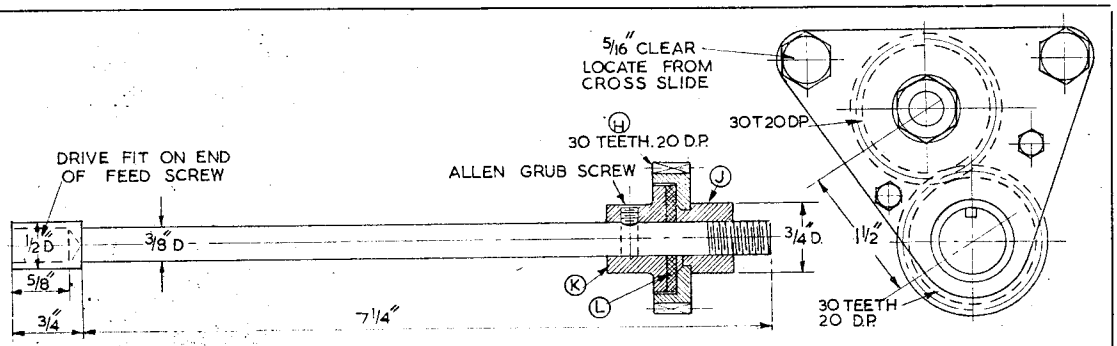


Fig. 3. *Fig. 4.*

From Start — to Finish

A DETAILED DESCRIPTION OF THE BUILDING OF A "M.E." EXHIBITION PRIZE-WINNER

By R. K. Boardman

THERE must be many articles similar to this which start with the phrase: "When I was a boy." I do not pretend to be very different from the others, but can truthfully say that ever since I was at school (nearly a quarter of a century ago), I have felt the urge to build myself a real "live steamer." The strongest deterrent has been the lack of ground on which to build a permanent track, while the war and the job of getting married and raising a family have been contributory factors.

After a short army service, I was confronted with the task of house-hunting. This resulted in the acquisition of a "piece or parcel of land" of about two acres, having a reasonable dwelling and a good outbuilding. Here were distinct possibilities, room in a corner of the garage for a small workshop, and plenty of orchard for a track—the bug had bitten!

There was much to be done! Garden to lay out and greenhouse to build; but to me, most important of all, a workshop to equip and a locomotive to build. About this time I had occasion to visit our local waterworks, and to my surprise I found the manager, a very old acquaintance, had just started building a *Maid of Kent* then being described by "L.B.S.C." A cursory glance through the articles aroused my interest, and from that day I became a regular subscriber to "Ours." Yes, it was to be a *Maid of Kent* with inside cylinders and Stephenson's link motion.

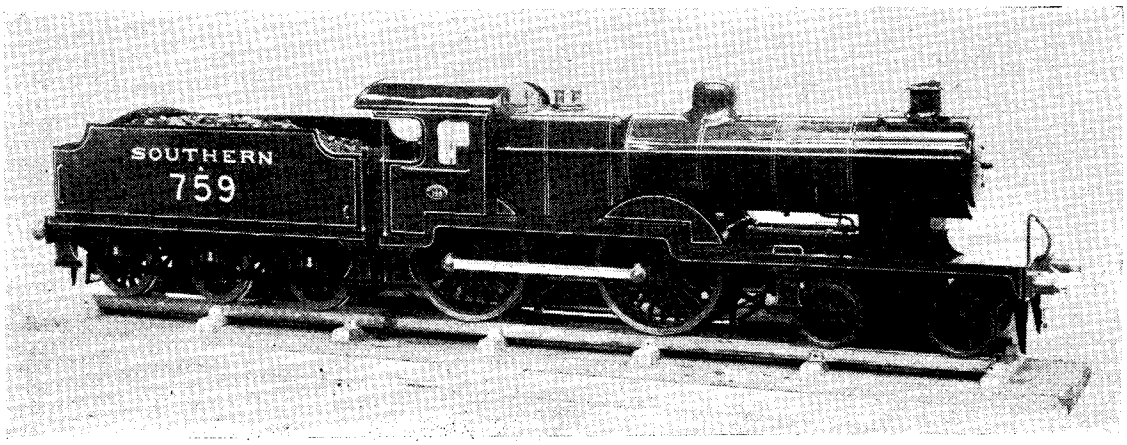
After consulting various advertisers' lists, sufficient castings were ordered to enable a start to be made on the chassis. Whilst waiting arrival of the materials, attention was turned to workshop facilities. In one corner of the garage a previous owner had installed the electric light plant and, for some reason best known to himself, had gone to great expense, and had this housed in a room of somewhat unorthodox shape and size. But this little room had great possibilities as a workshop.

The plant and batteries were duly moved to a temporary position in the garage where, incidentally, they *still* stand. The massive concrete block on which the little engine stood was far more of a problem. The size of the room did not permit the wielding of the sledge-hammer normally brought into action for such demolition work. Little by little it was reduced in size, revealing in its midst a most wonderful collection of scrap iron from old files to razor blades. The floor was then concreted, the outside weatherboard wall lined with plasterboard, benches erected for vice and lathe, and racks and cupboards fitted for tools and materials.

In the meantime, much thought had been given to the choice of a lathe. A 3½-in. seemed a little small for a 5-in. gauge job, and while still cogitating on the matter the next week's issue of THE MODEL ENGINEER arrived. This was reviewing the Boxford 4⅝-in. centre lathe and seemed to give the answer. My war gratuity, suitably augmented by funds from an ever-increasing overdraft, was used to settle the debt.

Whilst awaiting arrival of the lathe, other essential equipment was acquired. An old sensitive drill, purchased at a sale for 30s., was converted for electric motor drive. A flexible shaft complete with ¼-in. chuck, polishing buffs, etc., was obtained from one of our advertisers and fitted to an electric motor. Another small motor was acquired and fitted with an 8 in. green grit grinding wheel for tool sharpening. As my supply here is 100/110 volts, d.c. I was able through THE MODEL ENGINEER advertisers, to pick up several bargains in motors.

Sufficient equipment and material

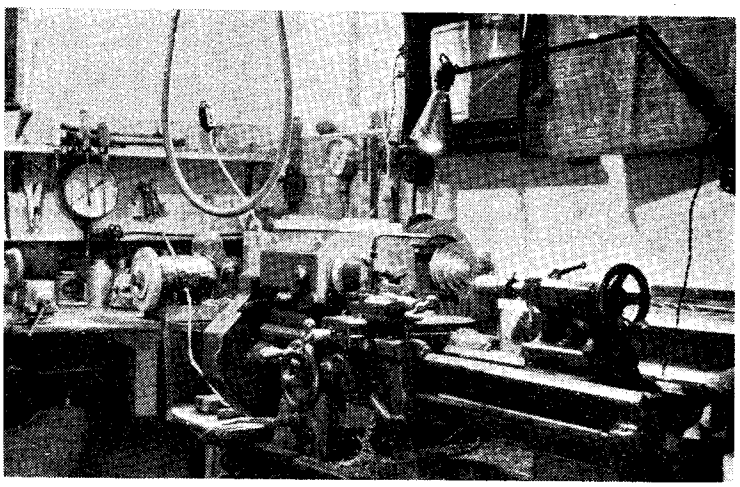


Mr. R. K. Boardman's 5-in. gauge S.R. 4-4-0 locomotive

was now to hand to enable a start to be made on the frames, these being cut from a sheet of 10-g. black mild-steel. All the holes were marked out and drilled satisfactorily with the two frames bolted together. Klang No. 1 was discovered when I had, as I thought, completed cutting the outline. I found that in marking out the arcs to clear the bogie wheels I had taken the centres in line with the bottom of the frames; this was incorrect, as further study of the drawing revealed, and I was now missing about $\frac{3}{16}$ in. of metal at the top of the arcs. Having oxy-acetylene available at our works, this metal was soon replaced, but the following evening was wasted in strenuously filing away the superfluous metal.

Klang No. 2 happened during the next stage of proceedings. Having available at the works a medium-sized shaping machine, I decided it would be a waste of time to file out the g.m. hornblocks. This would be such a simple matter on a shaper, each pair done in one setting by just altering the angle of the tool in the clapper box. But it didn't work out like that at all. The frames bolted together inside out were gripped in a large machine vice. The first cut down the side nearest the jaws was completed in a few seconds. The tool was changed and a cut commenced down the other side. After about six strokes on the automatic feed there was a horrid "crunch," and the ends of the frames literally "turned round and looked at me." Before too many inquisitive people could ask "what happened?" the frames were out of the vice, and I had retired to a quiet corner to examine the damage. Evidently, I had misjudged the strength of the frames, and in trying to hurry the job was hoping to do in one cut, what should have been done in two, at least!

Having recovered from the initial shock, I set about repairing the damage. Both hornblocks were unriveted and the frames straightened. The hornblocks were cold straightened and built up with Sifbronze where required. One of the webs had fractured and this was vee-ed out and Sifbronzed. When completed, they were once again fitted and riveted back on the frames. Next time they were filed out in my own workshop and completed ready for the axleboxes without incident. After these preliminary distractions, things seemed to go better.



A corner of the workshop, showing lathe and other useful equipment

Most of the castings had by now arrived and I was able to complete the main and bogie frames, etc. The lathe duly arrived, and was hastily put into commission. Wheels, axles, axleboxes, rubbing plates, etc. were machined without incident, as were the cylinders, pistons, crossheads, eccentric-straps and link motion.

The crank axle next came up for special attention, and it was decided that this should be fabricated with brazed joints. The necessary webs were made and assembled and prepared for brazing. After brazing, it was noted that even before the centre shaft had been cut away between the webs, the assembly had warped considerably during the process. Doubtless, this could have been straightened, but I did not feel inclined to take the chance, and decided to scrap it and start again. I toyed with the idea of turning one from the solid, but the eight pairs of centres required and the fact that the eccentrics would not be adjustable rather frightened me.

Finally, I decided on a compromise, which actually turned out to be very simple and effective, and can be recommended to others with a similar problem. The crankshaft was turned on two pairs of centres from the solid, as if making a simple two-throw crank, Fig.1. The centre journal between the cranks was left long enough so that it could be cut and one side bored and the other side turned to suit. The cut was made at $\frac{5}{8}$ in. from one web to allow for facing, and this was bored as detailed by setting up the centred end dead true in the chuck, and running the other end in a fixed steady. The male end of the other half was turned in similar fashion. Before removing from the lathe the two halves were fitted together to ensure that when pulled up tightly the cranks stood at 90 deg. with the correct one leading. Owing to the fine pitch of the threads a light rub on the conical face with fine emery cloth made correct positioning comparitively easy. The crank web was then drilled and tapped for a $\frac{3}{16}$-in. Allen grub-screw, Fig. 2. Before fitting the two halves together for keeps, the five eccentrics were slipped in position. Lastly, the axle was set up on the shaft centres and the ends turned down to fit the wheels.

This obstacle successfully overcome, I started assembling cylinders

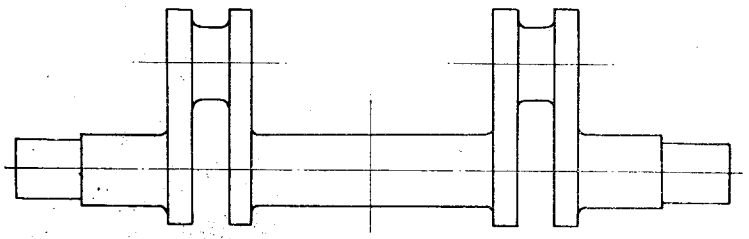


Fig. 1

and motion and fitting same to the chassis. When I came to fit the eccentric straps and expansion links to the die-blocks on the rocking shafts, I found that when the block was in position, the eccentric-rod fork fouled the rocking shaft. Dimensions of all parts were checked with the drawings, which revealed that some slight alterations to the design were necessary, as the clearance on paper was minus 1/64 in. This was easily rectified by making a longer pivot-screw for the die-block and placing a 7/64-in. spacer between die-block and rocking shaft, instead of the $\frac{1}{16}$-in. washer specified. At the same time it was decided to make the die-blocks with a small flange-head as an added inducement to the link to remain in the correct vertical plane.

The next stage was valve timing which started me off on a long search for practical information. I decided first that compressed air was a very useful adjunct to this process, and a little time was spent in installing a very antiquated garage pump which I had acquired in earlier years, and which was piped to two *ex*-R.A.F. oxygen bottles for storage. Timing of the gear was then completed visually in the prescribed manner, and I was horrified to find the enormous difference in maximum port openings to steam and the difference in cut-off positions when the valves were set with equal lead at T.D.C. and B.D.C. Moreover, I found that better results were obtained in reverse gear than in forward. All these facts were substantiated by compressed air tests. In order to make sure I had not made any serious mistakes in machining the parts or setting the eccentrics, I made a double-sized cardboard model of the valve motion, from which I was able to obtain a series of readings for valve movement in relation to degrees of crank rotation. These were plotted on a graph, which once again substantiated my actual results. Not content with this I decided to write to our trusted friend and authority "L.B.S.C." and obtain his views on the subject. I endeavoured to keep my letter as brief and to the point as possible, enclosing the necessary s.a.e. "L.B.S.C.'s" reply was most enlightening, he informed me that the only gear to give equal port openings in either direction, and at each end of the cylinder was the simple loose eccentric, all others vary. He stated that some of the figures for full-size engines would startle the uninitiated, and advised me to set the valves to give a tiny crack of lead at each dead centre in both directions, as specified, and she would run properly when under steam on the road. This was most reassuring and I realised I was just beginning to understand a little of the intricacies of valve-gears.

Following up "L.B.S.C.'s" remarks, I referred for technical information to a book in my possession entitled, *The Locomotives of Sir Nigel Gresley*, by O. S. Nock. Under reference to the rebuilds of the L.N.E.R. "1500's," class "B12," 4-6-0's I found most of the information required, together with details of the valve-gear modifications carried out on engines Nos. 8579 and 8559 complete with a chart showing comparative valve readings between the modified and the original design fitted to engine No. 8500. The old design appears very similar to that specified for the *Maid of Kent*, and the readings tabulated bear a remarkable resemblance to those I obtained on my little engine. I realise that No. 8500 had inside admission, whereas the *Maid* with slide-valves has outside admission, this, however, is counteracted by arranging the eccentrics to lead the crank. The gear is also fitted with open eccentric-rods to give maximum lead in mid-gear position. As the *Maid* has outside admission, the eccentrics are arranged to follow the cranks, and in order to obtain increased lead as the engine is notched up, the rods are crossed.

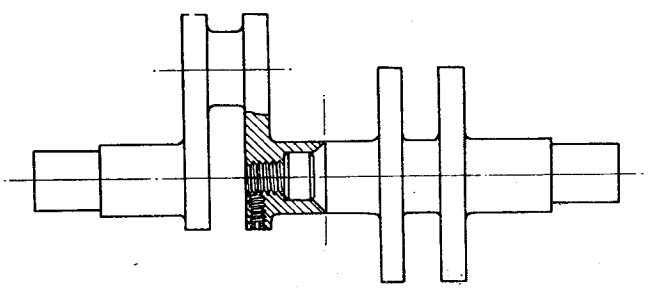


Fig. 2

It should be noted here that the arrangement of expansion links and lifting links on the L.N.E.R. "B12s" showed some variation from that prescribed for the *Maid*. On the big locomotives the lifting links were attached to the centres of the expansion links instead of at the bottom as on the *Maid*. The die-blocks were attached to connecting links, the latter being suspended from reasonably long swing links. In this way the expansion links and die-blocks were suspended on almost the same radii. The *Maid* valve-gear being very much simpler, the expansion link is suspended from the bottom on a comparatively long link, whereas the die-block being mounted direct on the rocking shaft has a very much shorter radius, and subsequently more die slip. It was also observed that the die slip was greater in forward gear than in reverse, this apparently being due to the expansion link being suspended from the bottom, instead of from the centre. I was sorry I had not the necessary information available to compare my locomotive with its full-grown counterpart, one of the Southern "L1s."

Before dismissing the subject of valve readings on full-size locomotives, it is interesting to recall the following data. On engine No. 8500 with a total valve travel of 4.195 in. and a full forward gear cut-off of 72 per cent. and 71½ per cent. for front and back ports respectively, we find a lead of plus 0.141 in. on the front port and plus 0.078 in. on the back port. We also find a maximum front port opening to steam of 0.883 in. against 1.062 in. for the back port. When the gear was redesigned for longer travel valves on engine 8579, the following readings are noted: Total valve travel 6.078 in. Full forward gear cut-off 72 per cent. and 69 per cent. for front and back ports respectively. Lead minus 0.078 in. for both ports. Maximum port openings to steam 1.18 in. for front and 1.399 in. for back port. It appears, therefore, that if we require equal cut-off, we must be prepared to have unequal valve openings. Thus, while engine No. 8500 was arranged with almost equal cut-off, engine No. 8579 was arranged with equal lead (negative). It is interesting to note that the improved version of the link motion as fitted on engine No. 8579 was arrived at mainly by fitting marine-type expansion links with longer slots.

While I had no desire to attempt to improve on the design already prescribed, I decided I would like

to try the gear with open eccentric-rods in order to improve forward running. The necessary alterations were made and the eccentrics re-adjusted. Subsequent tests showed that although the valve openings were very different, the cut-off was very much better in forward gear than in reverse, and there is much less die slip. I am prepared to sacrifice the advantage of increasing the lead when notching up for the sake of four regular beats. The reversing lever now has to be pulled back for forward gear; contrary I believe, to full-size practice.

This arrangement has proved most successful under steam. The beats are quite regular in full forward and full reverse gear. The engine notches up well in forward gear, but becomes a little irregular if notched up too far in reverse. There is plenty of steam and power. The safety valves are set to blow off at 80 lb. per sq. in. and blow off frequently if the fire is not kept under control. The wheels spin on the rails easily at 50 lb. pressure if the regulator is not handled with discretion.

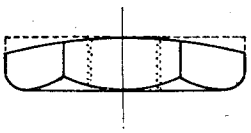


Fig. 3- *Sketch of brass stay-nut (5 BA.) radiused*

Maybe, the experienced steam enthusiast is already familiar with all the facts that I have recorded; if this is so, I am surprised at the lack of information revealed, when I was searching for practical knowledge among model locomotive builders. At one of the "M.E." Exhibitions I was introduced to a gentleman who was reputed to have written a book on valve-gears. After a few minutes conversation it was obvious we would not get very far. I was informed that Stephenson's link motion was as near perfect as makes no odds, and that the results I had obtained were due to the gear being incorrectly made or badly timed. I realise now that there are so many variations of this particular gear, that the above statement should not have been made without certain reservations; as it was, it was most misleading.

I cannot help feeling that there are still a lot of amateur locomotive builders who are under the same delusion as myself, that Stephenson's link motion is as near perfect as can be. Any difficulties they may have had in obtaining correct valve settings were due to their own incompetence or machining errors. I hope I can put the minds of these people at rest, and in particular anyone who is contemplating or building the *Maid of Kent* with link motion as a first-timer like myself.

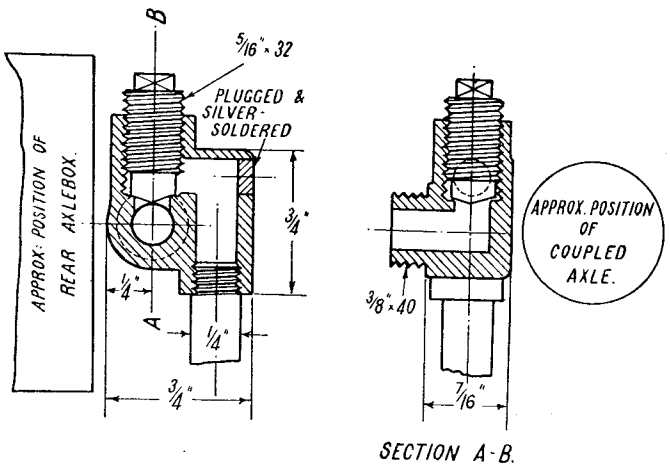


Fig. 4. *Modified blow-down valve*

Having crossed the *pons asinorum* after various diversions, a start was made on the boiler. It was decided here to carry out "L.B.S.C.'s" instructions even to the last of the 168 5-B.A. stays! With the aid of oxy-acetylene welding equipment this was completed without incident. All main joints were Sifbronzed, the tubes, backplate and foundation ring being completed with Easyflo. All firebox stays were nutted inside and out, cleaned up with acid and tinned liberally with plumbers solder. Incidentally, all stay-nuts were radiused (Fig. 3). This enabled them to be pulled up square with the stays on sloping surfaces, and the cracks left somewhere for the solder to run. Finally, the boiler was satisfactorily subjected to a hydraulic test of 200 lb. sq. in.

Boiler fittings called for some variation from the official instructions. The two holes had been drilled and tapped as prescribed in the bottom corners of the backplate for mudhole and blow-down valve. At this stage, the boiler was offered up to the chassis and it was noted that there was insufficient clearance between boiler and trailing axle to fit either of the types of blow-down valves described. The valve as shown (Fig. 4) was, therefore, designed, made and fitted, allowing about $\frac{1}{16}$ in. clearance. A special stainless-steel plug was made for the other hole having a thin flange and a small square head to clear the axlebox.

(*To be continued*)

AN AUTOMATIC CROSS-FEED

(*Continued from page* 443)

gearbox, so that the gear wheel could be pressed up against the Ferodo disc by means of a $\frac{3}{8}$ in. B.S.F. nut. It is then only a matter of lightly tightening up the nut to secure the gear wheel from rotating on its shaft, ample friction being available by virtue of the Ferodo disc.

The spigot on the "clutch plate" was also made $\frac{3}{4}$ in. diameter, so as to fit the $\frac{3}{4}$ in. diameter bush which was fitted to the other frame.

The lower spur wheel was bored out from $\frac{5}{8}$ in. to $\frac{3}{4}$ in. diameter to slide on the quill (Figs. 2 and 3), and a new keyway was cut $\frac{1}{8}$ in. by $\frac{1}{8}$ in., so that it could be carried round by the quill as the latter revolved.

I am not going to specify the dimensions of the frame plates, because anybody who may be inclined to make up this fitting will want to take the measurements from the lathe itself, as I did. The plates are of an irregular triangular shape, and the centres of the holes which carry the bushes for the spur wheels must be exactly $1\frac{1}{2}$ in. apart.

(*To be continued*)

Grooving V-Pulleys

By "Duplex

THE endless V-belt is now widely used for driving machine tools because of its many advantages over other forms of transmission.

It is enough to say that these belts score heavily on the grounds of quiet running, effective grip, and easy and cheap replacement.

Included in the belt manufacturer's general instructions, as to the lay-out of a V-belt drive, is the question of correct pulley design, for on this largely depends the efficiency and trouble-free working of the installation.

Steel or cast-iron pulleys are superior to those made of aluminium or soft alloys, for the latter are not so resistant to wear and, when the pulley grooves become worn, the efficiency of the drive is lowered. This applies more particularly to pulleys of small diameter with only a small arc of belt contact; slip and belt creep then tend to wear the grooves out of shape and polish the contact surfaces. As a rule, there is no need to buy finished pulleys, for they can quite well be machined in the small workshop from castings or from scrap ends of material.

However, judging from letters we receive, some beginners rather fight shy of machining the V-grooves in belt pulleys, but there is no real difficulty in this, provided one sets about the job in the right way. By using the following method, it has been found quite easy to machine the grooves in cast-iron pulleys up to some 6 in. in diameter, even when using a light lathe of $3\frac{1}{2}$ in. centre height.

It is advisable to mount the pulley blank by its finished bore on an arbor, so that the tailstock can be used to support the work and thus relieve the load on the mandrel bearings. The pulley can be secured against rotation by means of an Allen screw engaging a flat formed on the arbor. In this way, the pulley can be faced and its rim turned to size, leaving only the V-groove to be machined.

The value of the included angle is now standardised for V-belts, as is also the angle of the groove for pulleys of all diameters. Where a V-belt is bent round a pulley of small diameter, its shape, seen in cross-section, is altered in the way represented in Fig. 1. As the outside layers of the belt become stretched and those on the inside compressed, the two sides of the belt will come to lie more nearly parallel and the included angle will thus be decreased. From this it follows that the smaller the pitch diameter of the pulley, the smaller must be the angle of the pulley groove if the belt grip is to be fully maintained.

The " M " series of V-belts, $\frac{3}{8}$ in. in width, is commonly used for drives from $\frac{1}{4}$ h.p. electric motors, and for the motor pulley Messrs. Fenner recommend a groove angle of 32 deg. for a $1\frac{1}{2}$ in. pulley and an angle of 38 deg. for pulleys above $3\frac{1}{2}$ in. in diameter.

Where jockey pulleys form part of the drive, it is usually necessary to fit a round leather or plastic belt.

Although old-time lathes, driven by a round, gut belt, had mandrel pulleys with grooves of some 60 deg. or more included angle, a wedging action, giving a better grip, is obtained by reducing this angle to some 30 deg. for the smallest driving pulleys.

Commercially, pulley grooves are usually turned by taking a plunging cut with a tool formed to the exact shape of the finished groove, but this is, perhaps, rather much to expect of a light lathe when machining a large pulley, and the work is, therefore, done in stages.

Accordingly, the top-slide is set over, in either direction, to half the included angle of the groove, and the tool is then fed inwards at this angle in successive operations. It is always an advantage if the lathe top-slide can be rotated full-circle, but in some lathes this range of movement is not possible.

In a publication of Messrs. Percival Marshall, *In the Workshop*, Vol. III, descriptions are given of a number of additions to the Myford ML7 lathe, and included in these is a fitting that enables the top-slide to be set over to any required angle.

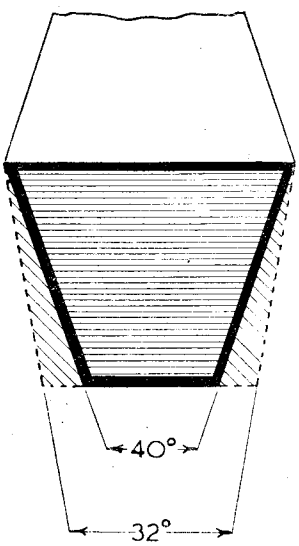


Fig. 1. Showing the effect of bending a V-belt round a small pulley

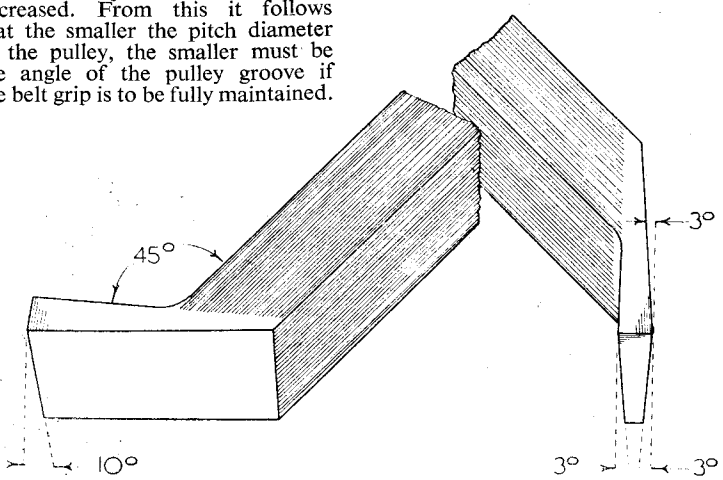


Fig. 2. A cranked tool for machining pulley grooves

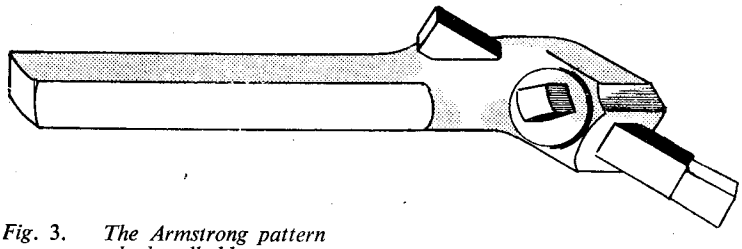
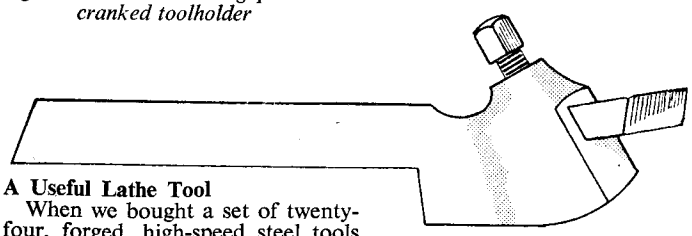


Fig. 3. The Armstrong pattern cranked toolholder



A Useful Lathe Tool

When we bought a set of twenty-four, forged, high-speed steel tools more than thirty years ago, some of the tools appeared to be of rather limited usefulness, but all, at one time or another, have proved almost indespensable for various awkward jobs in the lathe or shaping machine. The tool illustrated in Fig. 2 is no exception and it is now always used for machining V-grooves in pulleys. Although there is a great deal to be said in favour of a solid tool when heavy machining is undertaken, the Armstrong pattern, cranked tool illustrated in Fig. 3, is quite suitable for the present work and is more easily obtainable.

The forged tool has its cutting portion shaped like a parting tool, but the angular set enables the tool to be mounted in a way that avoids fouling the chuck jaws or shoulders on the work when machining the grooves in either a plain or a three-step pulley.

For the first operation, the tool is fed directly inwards, from the cross-slide, for a distance sufficient to give ample bottom clearance for the belt when running in the finished groove. As some workers have difficulty in what amounts to a parting-off operation, owing to the tool digging in and even breaking, it may be as well to remind them that these happenings can usually be avoided by tightening the slides until they become somewhat stiff to operate. This is best done by partially tightening the slide locking-screws, and there is then no need to interfere with the setting of the gib adjustment-screws.

Next, the top-slide is set over to half the included angle of the groove, and the first side of the groove is machined to the full depth and to half the finished width by taking a series of light cuts; the backgear should, of course, be engaged if the pulley is of large diameter or is made of cast-iron.

The finishing cut should be carefully taken in order to leave a smooth machined surface, as this is important in preventing belt wear. After the other side face of the groove has been turned in the same way, the belt should be tried in place to make sure that the back of the belt lies flush with the top of the groove. Finally, the outer, sharp edges of the groove are made slightly rounded so as to prevent the belt being damaged while running.

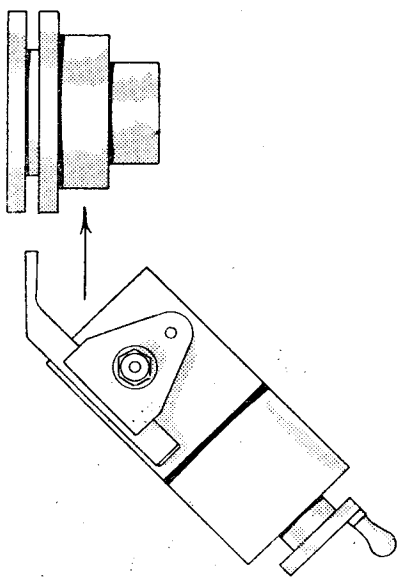


Fig. 4. The first operation of machining the groove to the full depth

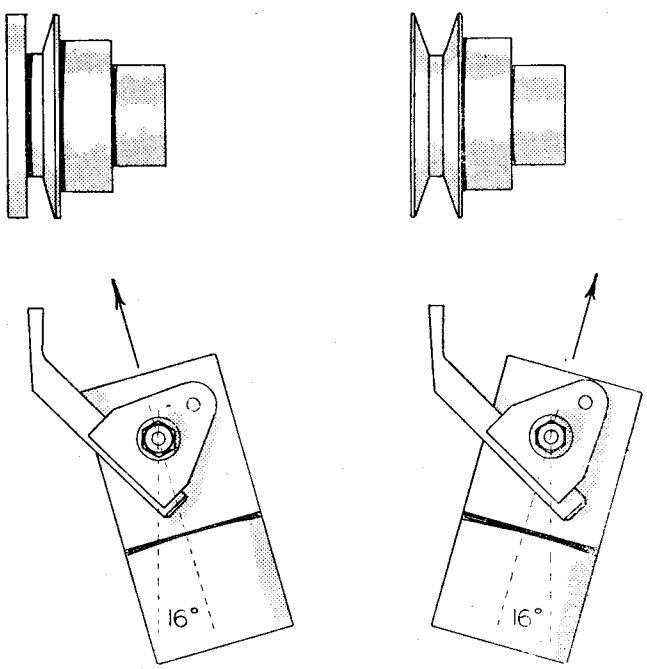


Fig. 5. Machining the two side faces to an included angle of 32 deg.

READERS' LETTERS

HYDROCARBON VAPOUR ENGINES AND LOCOMOBILES

DEAR SIR,—I do not think that the type of hydrocarbon vapour engine, described by Mr. Ralph Rasmussen in THE MODEL ENGINEER for March 4th, should be classed with those recently described by Mr. Westbury. The German system should be more correctly classed as a binary vapour engine, and this idea had been in the air many years before 1906. M. Du Trembley in France constructed engines—how many is not recorded—before 1850, and one of these, fitted in the ship *Bresil*, was extensively tested and reported on by Mr. George Rennie, Mr. J. W. Jamieson and the French engineer M. E. Gouin. Full details of their construction and mode of working were published in M. Du Trembley's *Manuel de Conducteur des Machines a Vapeurs Combinees, ou Machines Binaires* (Lyons 1850-51). Perhaps some French reader might be able to trace this book. At any rate, Pro. Rankine in his book on the steam engine (1866) has extracted some interesting points from these reports. In these engines the volatile liquids, available at that time, were ether, chloroform and carbon bisulphide. Of these M. Du Trembley selected ether for trial in his engines. The "Bresil's" engine had two cylinders of equal dimensions, one steam and one ether. The exhaust steam, of course, boiled the ether in an evaporator, getting condensed itself in the process, though I suppose a second condenser would be necessary for complete condensation. The average of a long series of trials were: Steam pressure in boiler 43.2 p.s.i., m.e.p., 11.6 p.s.i. Pressure in ether evaporator 31.2 p.s.i., m.e.p. 7.1. Thus the steam cylinder gave 62 per cent., and the ether 38 per cent. of the total power. It was considered that if the ether evaporator was removed, there would have been less back pressure on the steam engine, hence more steam power. However, it occurs to me that had the ether evaporator been better designed, there should have been no more back pressure than with a normal condenser.

It is true that vapour engines had been tried many years before this. I refer to Mr. Howard's patent ether and alcohol engine, 1825 or earlier: This was brought to a practical form in an engine that developed 24 h.p. at 33 r.p.m. I think that Mr. Howard's engine had good points, and should work well in small sizes, but I refrain from any further description, as it would probably be of little interest to the majority of readers, but it is interesting to note that Mr. Howard, himself refers to previous experiments by other people in boiling alcohol and using the vapour.

Now for Locomobiles.—The locomotive used by Mr. Egerton, appears to be an 1898 model. I had one many years ago, and I remember that the differential gear had no casing; this feature is clearly shown in the Land's End photograph. In addition to the wretched little band brake, my locomotive had squash tyre brakes, but I expect that Mr. Egerton had to take these off, when he fitted oversize tyres. They were not much good anyway. Now I am pretty certain that these early locos did not have piston rings fitted, hence leakage past the piston caused difficulty in maintaining steam, also heavy fuel consumption, and made the feed pump inadequate. I had a later model with a Mason "C" engine. This did have piston rings and a steam-tight piston, so that there was no serious difficulty in keeping up steam or the water level. I remember a 4-seater model, fitted with an all-enclosed engine. This looked a beautifully neat job, but the inevitable contamination of the oil by the water cracked the ball-bearings, and the Locomobile Co. went out of business. With a little more imagination on the part of the designer, and a firmer intention on the part of the manufacturers to turn out a really good job, the 1898 Locomobile would have been a lovely little runabout. As it was, I think Mr. Egerton did an amazingly good job to average 75 miles a day.

Yours faithfully,

Swanage. H. E. RENDALL.

STRAKES

DEAR SIR,—On page 257, of THE MODEL ENGINEER for March 11th, there is a sentence in the article by Mr. W. J. Hughes in which he states that he has seen the hind wheel strakes angled the wrong way on one or two free-lance jobs, where the builder hasn't known better! This is a statement that may have unfortunate results for an exhibitor, who may have copied a particular engine he has seen, or a picture of an early type where the strakes are angled the opposite way, and which may have been an engine built by one of the small firms, e.g., all Fowell engines. With the exception of the first two engines fitted with the "Box Patent Transmission," they were angled to keep the hind wheels bearing against the axle collars when moving forward; other engines are the "Dodman," Eddington & Steevens, Weeks, early Aveling engines, as illustrated on page 277, early Burrell engines and Fowler's ploughing engines.

Provided that the design of the axle collars and pins was adequate for both backward and forward motions, no undue wear or sign of strain may be expected, irrespective of which way the strakes are angled.

From the repairs point of view, however, I have found that, where the wheels tend to screw inwards, they may occasionally have to be removed for packing out to prevent the pinions grinding against the shrouding of the spur gears.

I hope, therefore, that judges at "M.E." Exhibitions will bear this letter in mind, and not condemn, out of hand, free-lance models just because they do not always conform to a practice that was fairly general, but not universal.

I was formerly works manager for Messrs. Fowell & Co. Ltd., Cromwell Ironworks, St. Ives, Hunts.

Yours faithfully,

Lee-on-Solent. W. F. THAIN. A.M.I.Mech.E.

OLD TYPE STEAM ENGINES

DEAR SIR,—With reference to the article by "Student" on page 244, March 4th issue, re his photograph No. 13, it is stated that this was built by J. and E. Wood of Bolton, date about 1903. Re-built in that year, with new piston and rod, bearings, etc., it may have been; but, refer to "A Treatise on the Steam Engine," by J. Scott Russell, 1851, where one rather similar is shown; this engine was surely built new, and first set up, about 1853, not 1903.

Yours faithfully,

London, N.W. H. H. NICHOLLS.

Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

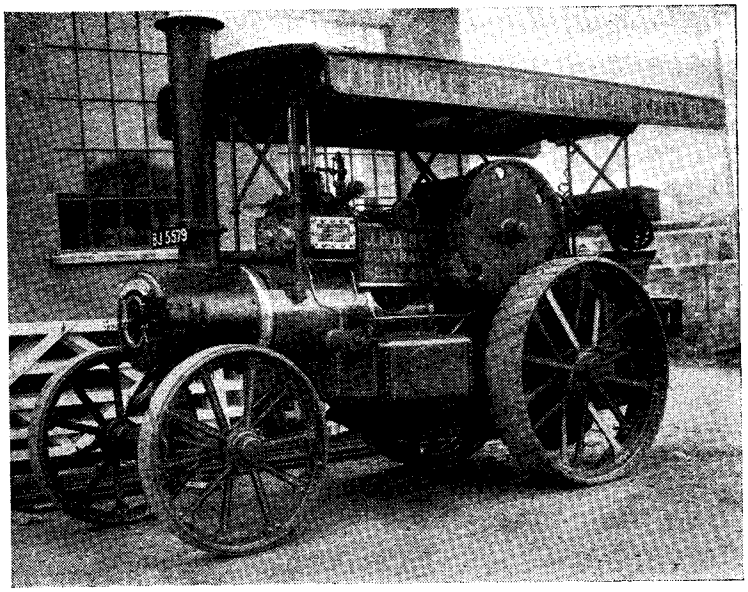
AN OVERHAULED "GARRETT"

DEAR SIR,—One regrets to see so many fine old traction engines and road locomotives being broken up, and may I say a few words re tractors. I think the "Garrett" was the finest tractor ever made. I have just overhauled our last "Garrett" and put it away for "keeps." Thirty-five years old, in wonderful condition, and steams beautifully. It has given great pleasure to the Plymouth and Exeter Model Engineers, who come and drive it around the yard every summer. I have copies of THE MODEL ENGINEER from the earliest volumes up to the present time, and what a wealth of knowledge they contain. Burrells, Fowlers, Marshalls, Aveling & Porter, they were all good, and especially the Burrell road locomotive known so well by the "show" people.

One of the finest Burrell scenic road locomotives which I have last seen, and in excellent condition, is at Messrs. J. Hickeys (yard), Cheshunt, Herts. (Worth a visit).

Yours faithfully,

Callington. G. C. DINGLE.



Mr. Dingle's last Garrett traction engine as re-conditioned

MODEL MARINE ENGINES

DEAR SIR, — It is an all too rare pleasure nowadays to see a description of a marine engine model in the pages of THE MODEL ENGINEER, and I congratulate Mr. Wilcox on a splendid piece of model production.

It is only the few who realise the immense amount of small detail work, which goes into a model of this type, but the final result, and the pleasure given to beholders, is ample repayment to those of my way of thinking.

I should judge that this is a model of a small engine of perhaps 700-800 i.h.p. intended to run at 150-160 r.p.m., and might have been designed for a medium sized steam yacht (possibly a tug, but the clean, rather light design suggests the former); at all events, from its length overall, some craft in which cargo space was not of first importance.

I should have liked to see more detail of condenser and circulation arrangement, which are not wholly clear from the illustrations, but shall live in hopes of seeing the model itself at the next "M.E." Exhibition, either in the competition, or on the S.M.E.E. stand.

Again congratulating the builder upon a noteworthy addition to the group of marine engine models.

Yours faithfully,

London, S.E.3. WM. T. BARKER. S.M.E.E.

STANDARDISATION

DEAR SIR,—I have taken THE MODEL ENGINEER regularly for several years now and it was only a few weeks ago when some of the model engineering fraternity told me of the valuable work you did in the early days in getting model engineers' screw threads into some sort of standardisation, which is a great boon to all.

For many years I have been advocating standardisation in terms of size that can be understood by all and is in common use today, to wit, the thousandth-of-an-inch.

Take drills, for a start; we have the series in the fractions of an inch, all odd sizes in 64ths, 9/32, 47/64 and so on; although you may be using them regularly, what a mental strain! Then we get to another nightmare, number drills 1 to 80, the higher the number the smaller the drill. On the top of that, another lunatic comes along with letter drills. Why not boil the whole lot down to call a drill by its diameter in thousandths, up to say 1 in. diameter. A $\frac{1}{8}$-in. drill would be 125, $\frac{1}{4}$ in. 250 and so on; every drill sold should be marked in this way.

The next headache we have is wire and sheet gauges. I have a standard handbook before me, and find there are six or seven "standard" gauges. All very interesting to some folks no doubt, but it would save a lot of trouble and loss of temper if one could say: I want a sheet of iron, brass or whatever it is, 6 ft. × 3 ft. × 0.031 in. which is straight to the point and is definite.

If you want to buy some sheet zinc you will fall foul of another "gauge," the zinc people have a mysterious gauge of their own, though fortunately I don't have to deal with it.

When you break a window you cannot order any understandable thickness; it is 21 oz. or so to the foot, so you feel the thickness and say, just the thing!

If you want to buy some lead sheet, you cannot order except at so many pounds to the foot.

When you want some tinplate you order by so many X's; 1X, 2X, 4X, and so on.

After all this I would suggest you go out and buy some wood screws, No. 2s, 4s and 12s, and tell me what these numbers represent.

Surely the time has come when engineers, and the public as well, can say I want a thing 0.250 in. ($\frac{1}{4}$ in.) or 0.875 ($\frac{7}{8}$ in.) which anyone with ordinary intelligence could understand.

It seems to me that it is time that something should be done to make all measurements far more understandable.

May I suggest you start some sort of campaign on these lines?

Yours faithfully

Winscombe. J. W. TRACY.

QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Ignition for "Atom V" Engine

I am constructing the "Atom V" 30 c.c. petrol engine to "M.E." Drawing P.E.7 and would be very pleased if you would answer the following:—

Would the Atomag Minor H.T. Magneto be suitable? What is its weight? If using coil ignition, please specify a suitable battery, voltage, and weight, also coil and condenser.

F.H.T. (Birmingham, 28).

The Atomag Minor H.T. Magneto would be suitable.

This magneto weighs a little over half a pound complete. Materials for its construction can be obtained from Roox Products, Beech, Alton, Hants.

If using coil ignition, we recommend that an accumulator should be used for supply, and the type of accumulator which we have found most suitable is the nickel-iron type having two cells.

Some accumulators of this type weighing about 1 lb. can be obtained from advertisers in THE MODEL ENGINEER. As they are of the alkaline type, it is important that the correct electrolite should be used.

Coils of a suitable high efficiency type can be obtained from Z. N. Motors Ltd., 904, Harrow Road, Willesden, London, N.W.10, who will also supply a suitable condenser.

Lathe Construction

I am proposing to construct a lathe, utilising material which is at present available, namely, two mild-steel bars 2½ in. diameter by 38 in. long, bored 1 in. diameter for the entire length, case-hardened and precision ground. I wish to fabricate the headstock and tailstock from mild-steel plate, and also the supports for the body. A headstock similar to that shown in Figs. 10 and 11 in The Beginner's Guide to the Lathe *is intended. Can I use the whole length of the bars, assuming that the headstock and tailstock will occupy 18 to 20 in.? What is the maximum centre height recommended? What thickness of mild-steel plate do you advise for the headstock, tailstock and rear of body? What size bearings do you advise? Is it advisable to locate the headstock centre directly over the centre of the parallel bars?*

H.E.H. (Shrewsbury).

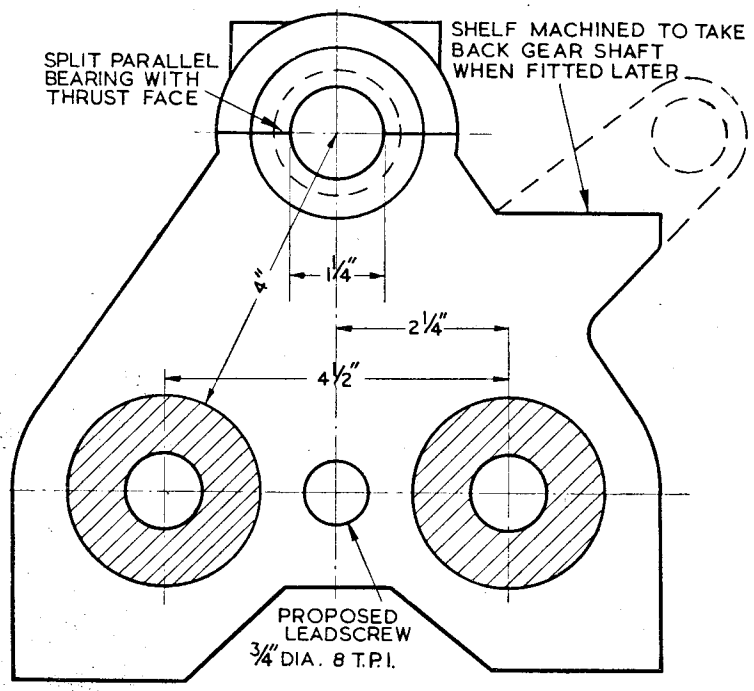
We are of the opinion that the hollow bars referred to will be quite suitable for making the bed, provided that they are accurately ground, as you state, and case-hardened. The full length of the bars can be used to give the maximum length capacity between centres.

It would be practicable to make a lathe of 4-in. centres height in this way, and if built up from mild-steel plate, the individual plates for the headstock and tailstock should not be less than ¾ in. thick. If bearings of the split parallel type are employed, a mandrel diameter of 1½ in. in the front bearing and down to about 1¼ in. in the rear bearing would be satisfactory, but with this method of construction there may be some advantages in using either a coned mandrel or external tapered contracting bushes instead of split bearings.

It is important that the clamping arrangements for both the headstock and the tailstock should be applied in such a way that they do not impose any bending stress on the bars. The dimensions between the bars, as shown on your sketch, appear to be quite satisfactory, also the proposed position of the lead-screw.

We advise keeping the centre of the mandrel immediately over the centre-line of the bed, in order to give the maximum diameter of swing, as the advantages of off-setting it would, in our opinion, be less important than those of maximum capacity.

In building up the headstock, some means of steadying or strutting the end plates as close to the mandrel as allowed by the maximum pulley diameter would be desirable, and the tailstock plates should also be strutted to avoid any possibility of deflection through thrust in an endwise direction.



End view, showing dimensions of a proposed lathe design by the querist, H.E.H. of Shrewsbury